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PHYSICS ABSTRACTS

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SECTION A OF SCIENCE ABSTRACTS

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* Alteration of headings: see note following page 44.

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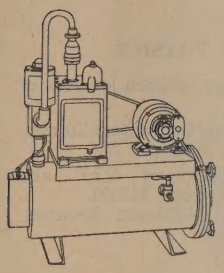

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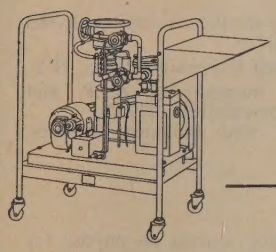

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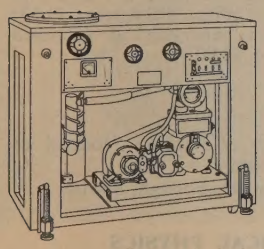

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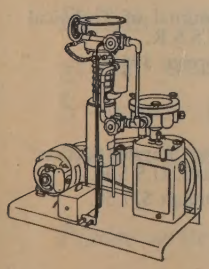

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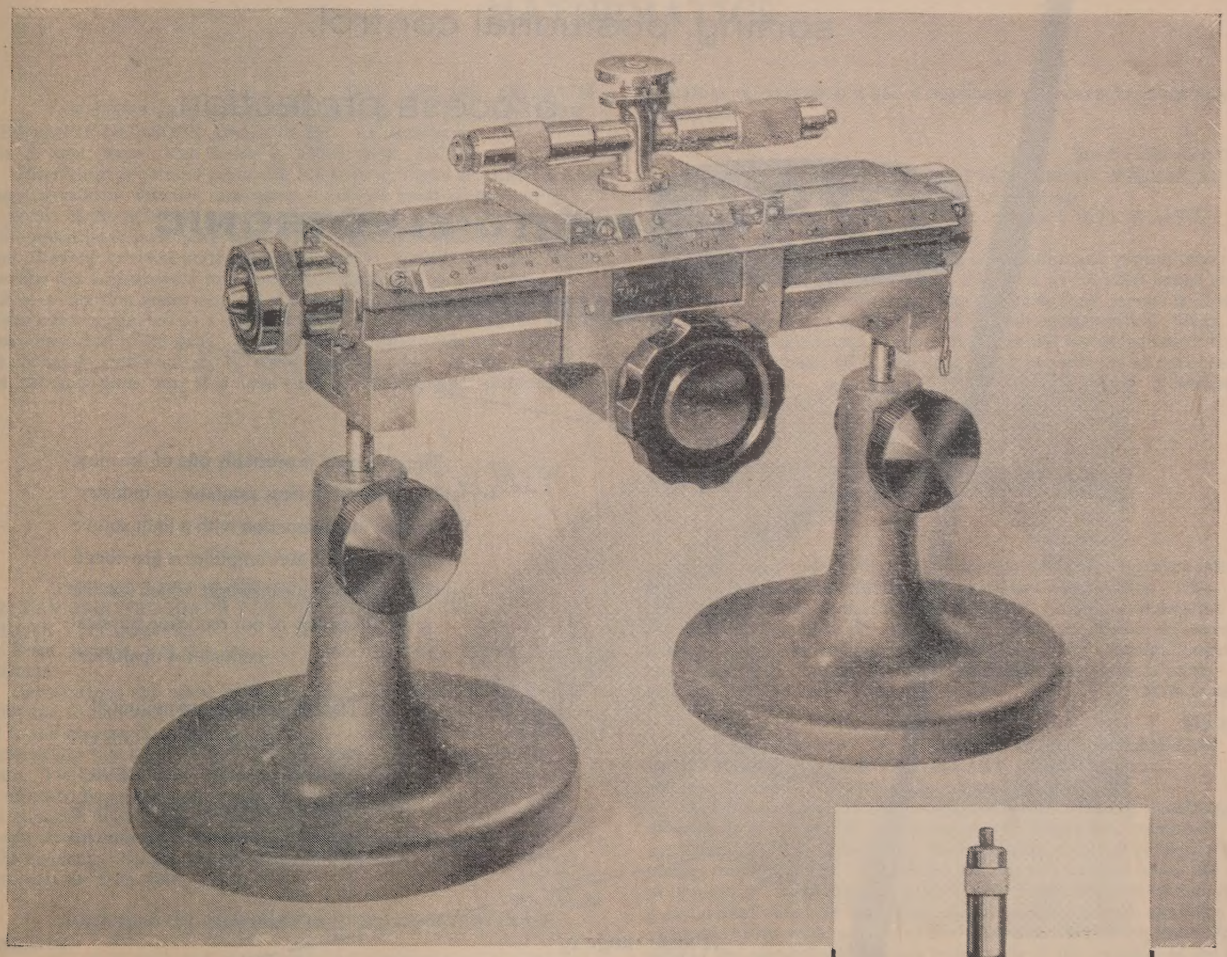

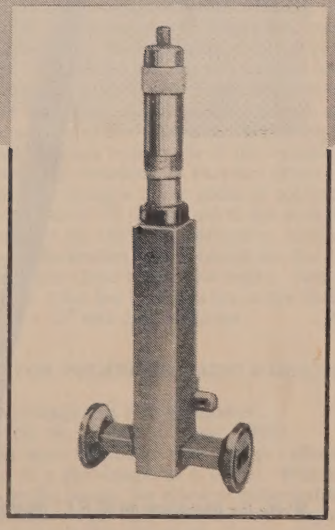

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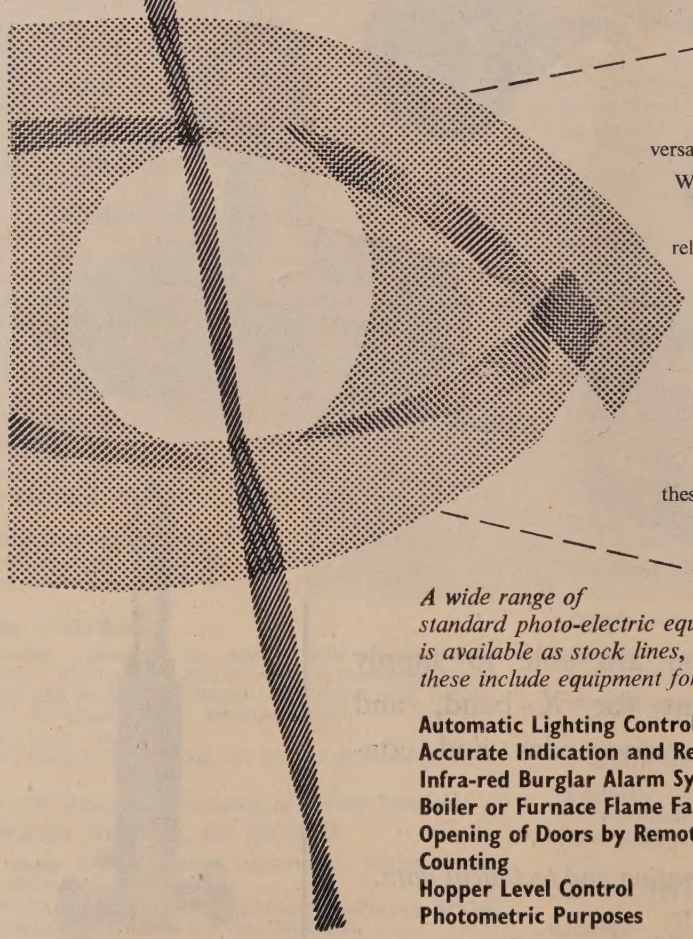

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PHYSICS ABSTRACTS

Volume 61 JANUARY 1958 Number 721

MATHEMATICS

518.5 : 681.142 : 621.317.79

1. AN ITERATIVE ANALOGUE COMPUTER FOR USE WITH RESISTANCE NETWORK ANALOGUES. I.C.Hutcheon.
Brit. J. appl. Phys., Vol. 8, No. 9, 370-3 (Sept., 1957).

When field problems involving sources or sinks are solved using resistance network analogues, currents must be applied to the nodes of the network such that each current is a desired function of the associated node potential. This requires repeated re-adjustment of every current until each is correct. A method is described whereby the adjustments are made automatically by a scanning switch, a function generator, an a.c. amplifier, and a set of triode valves each connected to a network node and having a memory capacitor connected to its grid. The solution is thus achieved rapidly, and changing problems can be solved continuously. Suitably modified, the apparatus may find uses such as solving other differential equations or providing a set of nonlinear resistors for fluid flow analogues. A.

518.5 : 621.317.729.1

2. DESIGN OF AUTOMATIC PLOTTERS OF EQUIPOTENTIAL LINES OF ANY SHAPE. E.Gudefin and R.Haug.
C.R. Acad. Sci. (Paris), Vol. 245, No. 6, 645-7 (Aug. 5, 1957).
In French.

Describes the design principle of an automatic plotter where one motor moves the probe in one direction at constant speed and the other motor, controlled by a servomechanism, moves it in the quadrature direction to the point of the set equipotential. When the angle between the actual probe movement and the direction of the first motor exceeds 45° C, the role of the two motors is reversed by telephone relays. F.Busemann

ASTRONOMY . ASTROPHYSICS

522.612

3. THERMAL PROBLEMS IN THE DESIGN OF A NEW STELLAR SPECTROGRAPH FOR THE OBSERVATORY AT MERATE. S.Guidarelli.
Atti Fond. Ronchi, Vol. 12, No. 4, 317-26 (July-Aug., 1957).
In Italian.

Calculations are made on the variations in focus of the spectrograph due to thermal expansions of the framework of the instrument and to the change of refractive index of the glasses. The instrument is thermally insulated so that no appreciable thermal gradients occur. The performance of the instrument is shown not to be adversely affected by reasonable changes in ambient temperature, from that at which adjustment was carried out. There is no appreciable change during the exposure period. It may however be necessary to make seasonal changes in adjustments unless the ambient temperature can be controlled. R.W.Fish

523.164.32

4. DURATION OF TRANSIENTS IN SOLAR RADIO NOISE. Ö.Elgarðy.
Nature (London), Vol. 180, 808-9 (Oct. 19, 1957).

High-speed recording on 200 Mc/s shows that solar bursts can be resolved into several short-duration pips. Histograms of pip-duration are given, showing sharp peaks at 0.28 sec. The pips have a strong tendency to occur in groups. Comparison with de Groot's observations on 400 Mc/s (Abstr. 9501/1957) shows that the mean pip-duration is halved when the frequency is doubled.

M.W.Ovenden

523.164.32

5. FREQUENCY DRIFT OF SHORT-TIME TRANSIENTS IN SOLAR RADIO NOISE. Ö.Elgarðy.
Nature (London), Vol. 180, 862 (Oct. 26, 1957).

Some preliminary results are reported from high-speed records from a two-channel receiver, central frequencies 199 and 200.5 Mc/s (time constant, 0.01 sec, bandwidth 0.3 Mc/s, noise factor 4). Typical records are reproduced. The mean duration of pips was 0.30 sec. Time-delays between frequencies gave drift velocities in both directions ranging from 10 Mc/sec^2 and upwards to rather high values. M.W.Ovenden

523.164.32

6. DETECTION OF SUBMILLIMETER SOLAR RADIATION. H.A.Gebbie.
Phys. Rev., Vol. 107, No. 4, 1194-5 (Aug. 15, 1957).

Observations were made with a two-beam interferometer of 30 cm aperture and a Golay-type thermal detector. Spectra were obtained from the interferograms by digital computation. The observing site was at an altitude of 3450 m. A figure shows the recorded spectrum in the range 1 mm to 300 μ. There are several maxima indicating regions of transmission. The principal regions of high absorption correspond to the calculated positions of pure rotation lines of H_2O^{16}. M.W.Ovenden

523.164.4

7. AN ATTEMPT TO DETECT LINEARLY POLARIZED RADIO EMISSION FROM THE GALAXY. J.M.Thomson.
Nature (London), Vol. 180, 495-6 (Sept. 7, 1957).

A 7.5 m paraboloid has been mounted as a transit instrument, to work on 159.5 Mc/s. At the focus, two dipole and reflector systems detecting radiation linearly polarized in two perpendicular planes were mounted. The whole system was rotated about the axis of symmetry, so that when linearly polarized radiation is received, a sinusoidal output is recorded. To allow for a small, spurious response from randomly polarized radiation from directions off the axis of the paraboloid, use has been made of the rotation of the plane of polarization of incoming radiation by Faraday effect in the earth's atmosphere, the expected changes in the plane of polarization being calculable. An upper limit of 1% can be set to the polarization over most of the region around the Galactic anticentre, although some positive evidence for polarization was obtained for the region 10° south of the Galactic plane close to the anticentre. Some evidence for polarization of ~1% from the bright large-scale feature of the Galactic emission at l = 15° was also obtained. M.W.Ovenden

523.164.42

8. EVIDENCE FOR POLARIZED RADIO RADIATION FROM THE CRAB NEBULA.
C.H.Mayer, T.P.McCullough and R.M.Sloanaker.
Astrophys. J., Vol. 126, No. 2, 468-70 (Sept., 1957).

The experiments were conducted with a 50 ft reflector on an altazimuth mounting, at a wavelength of 3.15 cm. With a plane-polarized feed-horn at the focus, the plane of polarization of radiation from the Crab Nebula would vary with the hour angle of the source. Drift scans were made across the nebula over a range of hour angle of 90° E to 90° W. Definite evidence for polarization ~10% was obtained. To eliminate the possibility that the observations were due to an elongated source in an elliptical aerial-beam, experiments were then conducted with the feed-horn rotating. Sinusoidal modulation of the detected radiation was observed, varying in the expected

fashion with the parallactic angle of the Crab Nebula. The observations at eastern hour angles gave 6.5% polarization, electric vector at position angle 149.5°. The western hour angle observations gave 7.5%, and 148°. The difference ~11° between the optical and radio planes of polarization can be explained by Faraday effect along the path of propagation of the radio radiation. Observations of the Cas A source gave no evidence for polarization. M.W.Ovenden

523.164.42

9. RELATIVE INTENSITIES OF FOUR PRINCIPAL RADIO SOURCES OBSERVED ON A WAVELENGTH OF 22 cm; A NOTE ON THE RADIO SOURCE SAGITTARIUS A. G.Westerhout.
C.R. Acad. Sci. (Paris), Vol. 245, No. 1, 35-8 (July 1, 1957). In French.

Observations were made with the Dwingeloo 25 m radio telescope (principal lobe approximately Gaussian, 0°.57 aperture to half-power, with side-lobes less than 20 dB; orientation to 2 min of arc in both co-ordinates). Some 55 discrete and extended sources were observed, concentrated towards the galactic plane. Relative intensities are given for the sources Cas A, Cyg A, Tau A and Vir A, with reference to the general background radiation, corrections being made for atmospheric absorption and nonlinearity of detector. Conversion to equivalent temperatures was made by two different methods, the agreement between the methods being good. An isophotal chart of the region of the galactic centre is given, and the nature of the Sagittarius A source is discussed. If the source is situated at the galactic centre, it would have dimensions of 40 x 85 parsec to half-intensity. The equivalent temperature in the direction of the source is approximately 190° K. M.W.Ovenden

523.164.85

10. RADAR ECHOES FROM OVERDENSE METEOR TRAILS UNDER CONDITIONS OF SEVERE DIFFUSION.
G.S.Hawkins and D.F.Winter.
Proc. Inst. Radio Engrs, Vol. 45, No. 9, 1290-1 (Sept., 1957).

It has been shown recently that the Lovell—Clegg scattering formula must be modified considerably for radar wavelengths < 2 m. An attenuation constant has been introduced for the case of trails in which the electron density was less than a critical density n_c corresponding to a particular wavelength (Abstr. 1691B/1957; Proc. Inst. Radio Engrs, Vol. 44, No. 9, 1192, Sept., 1956). The present paper considers the case of densities in excess of n_c under conditions of strong diffusion. Scattered power is derived in terms of the radar characteristics and it is shown that the scattering cross-section for this case is identical with that for underdense trails when diffusion is severe. G.D.Sims

523.51 : 539.16

11. URANIUM, HELIUM AND THE AGES OF METEORITES.
G.W.Reed and A.Turkevich.
Nature (London), Vol. 180, 594-6 (Sept. 21, 1957).

Recent measurements of the U content of stone and iron meteorites permit a re-examination of the accumulated data on the rare gases in meteorites with the object of establishing helium ages. The radiogenic-helium ages for the stone meteorites fall into two distinct groups, one with values up to about 1×10^9 years and the other with values of about 4×10^9 years. Comparison is made with radiogenic ages measured by other workers, who used primarily the $K^{40}-A^{40}$ method. In 8 cases out of 11 the radiogenic ages agree to within 15%. The cosmic-ray ages deduced by the authors from the He^3 contents of stone meteorites vary from 5 to 300 million years. The reasons for this are discussed and it is concluded that the evidence would not seem to support the argument that radiogenic helium has been lost preferentially to helium induced by cosmic rays in stone meteorites. T.A.Chalmers

523.66/.67

12. RADIO OBSERVATIONS OF THE COMET AREND—ROLAND. G.R.Whitfield and J.Hǿgbom.
Nature (London), Vol. 180, 602 (Sept. 21, 1957).

Interferometric observations on 38 and 81.5 Mc/s failed to detect any radiation from the comet, although solar emission caused some interference. Upper limits of flux densities are given. No scattering of radiation from radio stars seen through the tail could be detected, leading to an upper limit of 10^4 electrons per cm^3 for the r.m.s. variation of electron density in the tail. M.W.Ovenden

523.7 : 550.38 : 551.510.535

13. KODAIKANAL OBSERVATORY BULLETIN.
Astrophysical Observatory, Kodaikanal, India.

These bulletins are published every six months, and contain solar, magnetic and ionospheric data. They are also expected to include coronal and other data, when available.

523.745

14. RÉSUMÉ OF VISUALLY AND PHOTOGRAPHICALLY OBSERVED SOLAR ACTIVITY AT THE TIME OF 200-Mc/s NOISE STORMS NEAR 1954 SOLAR MINIMUM.
H.W.Dodson and E.R.Hedeman.
Astrophys. J., Vol. 125, No. 3, 827-30 (May, 1957).

The low activity of the sun during the calendar year 1954 enables an identification of the visually and photographically observed features responsible for radio-noise storms to be made. In this period, there were seven well-established noise-storms on 200 Mc/s; characteristics of the associated solar features are tabulated, and critical criteria for the emission of noise-storms on this frequency discussed. In summary, enhanced 200 Mc/s radiation was emitted from all regions in which solar flares occurred and from all regions with spot areas greater than 170 millionths and with magnetic fields greater than 1300 gauss. On the other hand, relatively large, bright plages and regions with relatively strong green coronal emission traversed the solar disc without concomitant increases in the 200 Mc/s flux. M.W.Ovenden

523.75 : 537.531

15. ROCKET OBSERVATION OF X-RAY EMISSION IN A SOLAR FLARE. J.W.Warwick and H.Zirin; T.A.Chubb, H.Friedman, R.A.Kreplin and J.E.Kupperian, Jr.
Nature (London), Vol. 180, 500-1, 501-2 (Sept. 7, 1957).

Warwick and Zirin maintain that their observations of cosmic-noise absorption during a particular flare are incompatible with the changes in ionospheric electron densities calculated by Chubb et al. from their rocket observations of X-radiation (Abstr. 6827/1957) of the same flare, unless the fractional change of electron density varies with height, increasing sharply above 75 km. It would, however, be difficult then to account for the phase anomalies observed during S.I.D.'s. They examine the relative merits of Lyman-α and X-ray origin of the ionospheric changes, and find in favour of the former. The required change in Lyman-α radiation to produce the observed cosmic-noise absorption in the particular case discussed would be too small (~ 14%) to be detected, in agreement with the observations of Chubb et al. They find no optical evidence on the sun for sources of X-rays in the 3 A region, and suggest that the observed X-radiation was produced locally in the earth's atmosphere.

Chubb et al. reply that the geometry of their detection apparatus precludes a local origin for the observed X-rays. They point out that the computed electron density changes are very sensitive to the assumed values of recombination coefficients at various heights, and give calculations suggesting that very little of the X-radiation penetrated below 78 km. A lowering of the D-layer base would be expected only for much greater flares, and in fact no such lowering or indeed fade-out or other form of S.I.D., was observed with this particular flare. The occurrence of a large increase in X-radiation with a small flare suggests that for flares producing S.I.D.'s, the X-ray increase must be much greater. M.W.Ovenden

523.75 : 538.566.3

16. A NEW CHROMOSPHERIC ERUPTION EFFECT.
M.Waldmeier.
Naturwissenschaften, Vol. 44, No. 16, 439 (1957). In German.

Following a solar flare of intensity 2 at 10 h 40 m U.T. on 16th April 1957, observations at Riedern (near Bern) of the field-strength of the long-wave radio transmissions from Ongar (near London) ~ 800 km distant showed the usual enhancement effect on wavelength 2950 m, commencing at 11 h 00 m and attaining a maximum amplitude of ~ 6 dB. For the longer wavelength transmission at 5320 m, however, an unexpected reduction in signal strength was observed to occur, the maximum decrease of field-strength, at 11 h 45 m U.T., being ~ 14 dB. D.R.Barber

523.75 : 523.165

17. ACCELERATION OF COSMIC RAYS IN SOLAR FLARES.
E.N.Parker.
Phys. Rev., Vol. 107, No. 3, 830-6 (Aug. 1, 1957).

It is shown that the white-light cosmic-ray solar flare of February 23, 1956 expended of the order of 2×10^{32} ergs of energy, or 10^4 ergs/cm^3. The energy apparently came from a 500 gauss force-free magnetic field initially occupying the site of the flare. It is shown that the 500 gauss field, besides supplying the flare energy, will produce fluid motions of sufficient velocity to accelerate ions from thermal to relativistic energies by Fermi's mechanism in about 2 minutes. The theoretical energy spectrum of the model is in agreement with the observed spectrum. About 1% of the total flare energy is converted to relativistic particles and the remainder is dissipated through thermal processes to produce the observed optical radiation. A.

523.854

18. THE LARGE-SCALE STRUCTURE OF THE GALAXY. F.J.Kerr, J.V.Hindman and M.S.Carpenter.
Nature (London), Vol. 180, 677-9 (Oct. 5, 1957).

By combining the results of 21 cm radio sweeps (5^0 apart in the Galactic longitude) on a strip of sky, 8^0 wide, around the Milky Way, made at Sydney, with those obtained previously at Leiden, it has been possible to construct a composite spiral diagram of the Galaxy as well as a relief map of the same regions showing major departures of the H gas layer from a principal plane containing the sun, and sloping downwards from the conventional "Galactic plane" at 1.5^0 towards the Galactic centre at the longitude decay of 327.5^0. It is found that, (i) the Galaxy has a multi-spiral structure; (ii) the arms are trailing, with clockwise rotation; (iii) although not conclusive, the observations suggest two or more convolutions of the major arms about the axis of rotation; (iv) within 3 to 7 kiloparsecs from the centre, the velocity pattern is markedly asymmetric; (v) H is confined to a relatively thin layer (~ 250 parsec between half-density limits) with the gas layer very flat in the innermost zone; (vi) neutral H is a major constituent of the outer regions, although the proportion is only about 2% when integrated over the whole Galaxy. D.R.Barber

523.875

19. EQUIVALENT WIDTHS OF BALMER LINES OBSERVED IN STELLAR SPECTRA. S.Matsushima.
C.R. Acad. Sci. (Paris), Vol. 245, No. 12, 998-1000 (Sept. 16, 1957). In French.

Observed equivalent widths of H_β, H_γ, and H_δ are used to form "iso-equivalent-width curves" in a series of stellar temperature–surface-gravity diagrams. The experimental results are compared with estimated values, based on values of log surface gravity, for each spectral type, using the absolute visual magnitude scale of Keenan and Morgan. For the hot stars computed values are found lower than those observed, and somewhat higher for the super-giant stars of types B8 to F0. In the case of the hot stars, the observed values are more sensitive to changes of surface gravity than are the theoretical values. The lack of accordance between observation and theory found in the results for the cooler stars may arise from a non-validity of the hypothesis of local thermodynamic equilibrium for these particular objects. D.R.Barber

529.786 : 531.711

20. THE UNITS OF TIME AND LENGTH. L.Essen.
Nature (London), Vol. 180, 137-8 (July 20, 1957).

The constancy of the velocity of light is regarded as an essential feature of any system using a wavelength standard of length. An ideal system would define units of length and time in terms of the wavelength and frequency of radiation from a given source, but in practice the Cs line could be used for standard frequency and a suitable light-source for standard wavelength. Consideration is given to the time system in which interval is based on the atomic unit and epoch on astronomical measurements. R.A.Newing

529.786 : 621.317.39

21. COMPARISON OF CAESIUM RESONATORS BY TRANSATLANTIC RADIO TRANSMISSION.
L.Essen, J.V.L.Parry and J.A.Pierce.
Nature (London), Vol. 180, 526-8 (Sept. 14, 1957).

Gives particulars of the method used for the comparison, and tabulates the frequency differences found on about 60 dates between November 1956 and June 1957. The standard deviation of the observed daily difference is 0.4 parts in 10^9, which is about equal to the resultant of all the errors in the measurement. The main error arises from the transmission variations over the night-time trans-atlantic path (day-time transmission was not possible during the tests reported here). F.F.Roberts

PHYSICS

53

22. IMPROVING THE QUALITY AND EFFECTIVENESS OF INTRODUCTORY PHYSICS COURSES. REPORT OF A CONFERENCE SPONSORED BY THE AMERICAN ASSOCIATION OF PHYSICS TEACHERS.
Amer. J. Phys., Vol. 25, No. 7, 417-24 (Oct., 1957).

The final report of a conference, held at Carleton College, September 5-8, 1956, on the improvement of the quality and effectiveness of introductory physics courses is presented. A.

53

23. SYLLABUS FOR THE ONE-YEAR COLLEGE COURSE IN PHYSICAL SCIENCE. G.Holton.
Amer. J. Phys., Vol. 25, No. 7, 425-9 (Oct., 1957).

Prepared at the request of the AAPT Conference (see preceding abstract) to illustrate how the recommendations of its report may be implemented, this syllabus describes a physical science course for students not intending to major in that field. A.

53

24. ONE-YEAR INTRODUCTORY COURSE IN A LIBERAL ARTS COLLEGE. W.C.Michels.
Amer. J. Phys., Vol. 25, No. 7, 430-2 (Oct., 1957).

Prepared at the request of the AAPT Conference (see the two preceding abstracts) to illustrate how the recommendations of the report may be applied in a small liberal arts college, this syllabus describes a one-year course for students majoring in science and mathematics, as well as for others not planning to major in those fields. A.

53

25. THREE-SEMESTER INTRODUCTORY COURSE FOR ENGINEERS AND SCIENCE MAJORS. R.M.Whaley.
Amer. J. Phys., Vol. 25, No. 7, 432-5 (Oct., 1957).

Prepared at the request of the AAPT Conference (see the three preceding abstracts) to illustrate how the recommendations of the report may be applied in a large university, this syllabus describes a three-semester course for engineers and science majors. A.

53

26. LABORATORY INSTRUCTION IN GENERAL COLLEGE PHYSICS. REPORT OF THE COMMITTEE ON CONCLUSIONS OF THE CONFERENCE ON LABORATORY INSTRUCTION IN GENERAL PHYSICS [JUNE 17-19, 1957 AT THE UNIVERSITY OF CONNECTICUT, STORRS].
Amer. J. Phys., Vol. 25, No. 7, 436-40 (Oct., 1957).

53

27. ELEMENTARY PHYSICS LABORATORY INSTRUCTION AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY. S.C.Brown.
Amer. J. Phys., Vol. 25, No. 7, 446-51 (Oct., 1957).

A survey of the laboratory objectives and teaching methods is given. Specific examples of the type of elementary experiments used are presented. A.

FUNDAMENTALS

530.112

28. THE ETHER AND SPECIAL RELATIVITY. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 245, No. 9, 891-4 (Aug. 26, 1957). In French.

The modified region around a moving body (see Abstr. 9510/1957) is considered as a closed inertial system. A correspondence is set up between events in two such systems and, although the transformation equations are shown to have the Lorentz form, they have a different physical significance. R.A.Newing

530.12 : 530.145

29. ON THE THEORY OF RELATIVISTIC DIFFUSION. H.Rudberg.
University of Uppsala Dissertation (1957) 65 pp.

A relativistically invariant theory of particle diffusion is set up and discussed in one and two space dimensions. It is shown that there exists a close connection between the diffusion equations and

certain relativistic wave-equations of quantum field theory. An interpretation of Dirac's theory of the electron is given in terms of a stochastical model in which the electron moves with the velocity of light alternately in two directions defined at each point by the four components of the Dirac spinor. G.Stephenson

530.12

30. THE COMPACTIFICATION OF A LORENTZ SPACE AND SOME REMARKS ON THE FOUNDATION OF THE THEORY OF CONFORMAL RELATIVITY. H.Rudberg.
University of Uppsala Dissertation (1957) 24 pp.

It is shown how a real Lorentz space of n dimensions may be imbedded conformally into a compact Riemannian space on which inversions are globally conformal. The geometrical significance of this compactification is discussed in detail by using the result that conformal transformations can be dealt with as orthogonal transformations in an (n + 2)-dimensional space. An application is given to the compactification of a two-dimensional Lorentz space and it is shown that all Lorentz-conformal transformations can be put into the form $w = (az+b)/(cz+d)$, where $z = z_1 + ez_2$ and $e^2 = 1$. The connection between this work and the conformal theory of relativity is also discussed. G.Stephenson

530.12

31. ON THE CONSERVATION THEOREMS AND CO-ORDINATE SYSTEMS IN GENERAL RELATIVITY. A.Trautman.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 7, 721-8 (1957).

A definition of the conservation quantities in general relativity is given for field—"pole-particle" interaction. It is shown that the number of conservation laws is equal to the number of independent isometries in the space-time continuum, and that there exist ten such conservation laws only in spaces of constant curvature. The relation between these conservation laws and the symmetry properties of space-time is discussed and it is shown that the idea of energy is closely related with the stationary character of a space-time. G.Stephenson

530.12

32. THE ENERGY-MOMENTUM TENSOR IN VARIATIONAL RELATIVITY. J.M.Souriau.
C.R. Acad. Sci. (Paris), Vol. 245, No. 11, 958-60 (Sept. 9, 1957). In French.

A general tensor is introduced for the author's variational system, and conservation equations are derived. It is noted that the new scheme reduces to classical results for gravitational and electromagnetic fields, and for a relativistic perfect fluid.

R.A.Newing

530.12

33. PROBLEM OF INITIAL CONDITIONS. Y.Fourès-Bruhat.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1384-6 (Oct. 21, 1957). In French.

The initial value problem for the field equations of general relativity is reduced to the solution of a set of quasi-linear elliptic-type equations by the use of isothermal coordinates.

R.A.Newing

530.12

34. ISOMORPHISM OF THE RELATIVISTIC DYNAMICS OF A SYSTEM OF PARTICLES AND THE CLASSICAL STATICS OF A SYSTEM OF STRINGS. O.Costa de Beauregard.
Cahiers de Phys., Vol. 11, 137-48 (April, 1957). In French.
See Abstr. 4152 (1954).

530.12

35. RELATIVITY AND SPACE TRAVEL.
J.H.Fremlin; H.Dingle.
Nature (London), Vol. 180, 499-500, 500 (Sept. 7, 1957).

This is a contribution to the controversy between Dingle and McCrea (Abstr. 1881-2, 6858, 7568/1957). Some of the phenomena observed by a traveller who goes rapidly to Alpha Centauri and back are compared to those observed by his brother who remains at home. From a consideration of the Fitzgerald—Lorentz contraction, it is concluded that the brothers will age differently.

J.H.Fremlin

530.12

36. APPROXIMATE SOLUTIONS OF THE EINSTEIN EQUATIONS FOR ISENTROPIC MOTIONS OF PLANE-SYMMETRIC DISTRIBUTIONS OF PERFECT FLUIDS. A.H.Taub.
Phys. Rev., Vol. 107, No. 3, 884-900 (Aug. 1, 1957).

An approximation procedure is developed and applied to the problem of determining the gravitational and hydrodynamical fields associated with a plane-symmetric distribution of a perfect fluid with arbitrary caloric equation of state in isentropic motion. Special relativistic hydrodynamics in co-moving coordinates are discussed and methods are given for solving specific problems. These solutions provide a zero-order approximation of the corresponding general relativistic problems. The linear equations describing the higher order corrections are discussed and the application of the method of characteristics is pointed out. The existence of shock waves in special relativity makes plausible their existence in general relativity, and they may be used to avoid using physically unacceptable solutions of the field equations. A.

530.145

37. ON THE PROBLEM OF THE CONNECTION BETWEEN ORDINARY AND ISOTOPIC SPACES. G.A.Sokolik.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 6, 1206-9 (1957). In Russian.

The wave-equation is written symmetrically with respect to ordinary and isotopic space, using generalized Γ-functions. Transformation properties of these matrices in the generalized space are discussed. Possible connections with Gell-Mann's scheme are noted.

G.E.Brown

530.145

38. INTEGRAL REPRESENTATION OF CAUSAL COMMUTATORS. R.Jost and H.Lehmann.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1598-610 (June, 1957). In German.

Using causality and the spectrum of the momentum operators, an integral representation for the matrix elements of commutators between momentum eigenstates is given. W.A.Hepner

530.145

39. THE CAUSAL FORMULATION OF QUANTUM MECHANICS OF PARTICLES (THE THEORY OF DE BROGLIE, BOHM AND TAKABAYASI). H.Freistadt.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 1, 1-70 (1957).

Review of the non-relativistic and relativistic theories.

W.A.Hepner

530.145

40. MANY-BODY PROBLEM IN QUANTUM FIELD THEORY. A.Klein and C.Zemach.
Phys. Rev., Vol. 108, No. 1, 126-38 (Oct. 1, 1957).

A formalism for the covariant description of scattering processes involving composite particles is derived from first principles. Its basic ingredients are the Green's functions of quantum field theory combined with a physically sound formulation of the adiabatic hypothesis. Explicit expressions are presented for various examples of nucleon—nucleus and boson—nucleus collisions. It is shown that the impulse approximation can be formulated for such problems. A general method of obtaining electromagnetic moments of nuclei, based on the scattering formalism, is also derived. The normalization condition for covariant amplitudes is discussed and its application to bound-state problems reviewed. In particular, a method of carrying out perturbation theory for the discrete spectrum is suggested. A.

530.145

41. THE PARITY NON-CONSERVATION AND THE STRENGTH OF THE INTERACTION OF ELEMENTARY PARTICLES.
S.Tanaka.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1364-7 (May, 1957).

A theory of the strengths of the various interactions and of parity violation, based on the concept of two-dimensional coordinates relating to the internal structure of elementary particles.

J.W.G.Wignall

530.145

42. MATHEMATICAL STRUCTURE OF RENORMALIZABLE FIELD THEORIES. G.Mohan.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 3, 440-71 (1957).

The reduction formula technique of Lehmann, Symanzik and Zimmermann remains valid with a weaker asymptotic condition, and almost all the S-matrix elements are expressible in terms of the vacuum expectation values of the T-products of the Heisenberg fields. Some of the properties of these functions are studied and a general method of obtaining some asymptotic properties is developed.

W.A.Hepner

530.145

43. ON A GENERALIZATION OF DIRAC'S EQUATION FOR HEAVY FERMIONS. P.Merat.
C.R. Acad. Sci. (Paris), Vol. 244, No. 26, 3131-3 (June 24, 1957). In French.

Starting from the eight-row matrices previously introduced

(Abstr. 8983/1957), the generalization consists in considering a 4-dimensional isotopic spin space, whose fourth dimension is ordinary time, whereas its other three dimensions are distinct from ordinary space-time. A transformation group (isotopic group) in this space, isomorphic to the Lorentz group, is introduced and a generalization of the law of conservation of matter is obtained.

L.Pincherle

530.145

44. ON A GENERALIZATION OF DIRAC'S EQUATION FOR HEAVY FERMIONS INTERACTING WITH MESON FIELDS. P.Merat.
C.R. Acad. Sci. (Paris), Vol. 245, No. 1, 38-40 (July 1, 1957). In French.

The notion of isotopic group (see preceding abstract) leads to the introduction of meson fields which transform in an irreducible way with respect to the isotopic transformations. In particular, the interaction of the (iso) vector meson field with the particle associated to the generalized Dirac equation for heavy fermions is studied and it is found that this theory gives a new dipolar meson interaction in certain reactions. L.Pincherle

530.145

45. NON-RELATIVISTIC LIMIT OF THE HYDRODYNAMIC REPRESENTATION OF THE DIRAC EQUATION. P.Hillion.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1394-6 (Oct. 21, 1957). In French.

This is shown to be equivalent to the hydrodynamic representation of the Pauli equation. R.J.N.Phillips

530.145

46. ON THE MEASUREMENT OF VELOCITY OF RELATIVISTIC PARTICLES. Y.Aharonov and D.Bohm.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 3, 429-39 (1957).

Koba's criticism of Dirac's explanation why $\pm c$ are the only possible eigenvalues of a velocity component of a Dirac particle is analysed. W.A.Hepner

530.145

47. HEAVY-FERMION MASS SPECTRUM. D.Kleitman.
Phys. Rev., Vol. 107, No. 5, 1453-4 (Sept. 1, 1957).

The heavy-fermion mass spectra predicted by the Lagrangians for strong interactions of heavy particle fields, as suggested by Schwinger and by Gell-Mann, are investigated. W.A.Hepner

530.145

48. RELATIVISTIC WAVE EQUATIONS FOR SPIN-2 PARTICLES WITH UNIQUE MASS. O.Brulin and S.Hjalmars.
Phys. Rev., Vol. 107, No. 6, 1730-1 (Sept. 15, 1957).

With an operator mass term it is possible to satisfy the requirement of a unique mass. W.A.Hepner

530.145

49. MULTIPLE PRODUCTION OF PARTICLES AND HYDRODYNAMICAL ASPECT OF QUANTUM THEORY OF FIELD. M.Namiki and C.Iso.
Nuovo Cimento, Vol. 6, No. 1, 245-9 (July, 1957).

Some questions concerning Landau's phenomenological theory on the motions of the meson cloud are examined. W.A.Hepner

530.145

50. THE KOHN—HULTHÉN VARIATIONAL PROCEDURE FOR THE SCATTERING OPERATOR AND THE REACTANCE OPERATOR. I. ELEMENTARY FORM OF THE VARIATIONAL PRINCIPLES. H.E.Moses.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 1, 120-43 (1957).

Expressions for the operators are derived by a generalization of the Kohn—Hulthén method in abstract form, and compared with the proofs in the x-representation. They are illustrated for four cases: the radial equation for zero angular momentum; the [1]- and [3]-dimensional scattering problems; and electron scattering by an atom. The advantage of the method is that, for any trial function, the reactance operator is Hermitian, and hence the corresponding scattering operator is unitary. N.M.King

530.145

51. THE KOHN—HULTHÉN VARIATIONAL PROCEDURE FOR THE SCATTERING OPERATOR AND THE REACTANCE OPERATOR. II. PROCEDURES INDEPENDENT OF THE NORMALIZATION OF THE TRIAL FUNCTIONS. H.E.Moses.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 1, 144-59 (1957).

Alternative forms of the principles derived in Pt I (preceding abstract), independent of the normalization, are established, and illustrated by application to the special cases treated previously. N.M.King

530.145

52. THE DETERMINATION OF THE SCATTERING POTENTIAL FROM THE SPECTRAL MEASURE FUNCTION. IV. "PATHOLOGICAL" SCATTERING PROBLEMS IN ONE DIMENSION. I.Kay and H.E.Moses.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 1, 230-42 (1957).

One of the conditions of Pt III (Abstr. 4199/1956) is replaced by the assumption that the reflection coefficient has poles on the positive imaginary axis which do not correspond to point eigenvalues, and conversely that there are point eigenvalues which do not correspond to such poles. It is shown that the potentials behave like the sum of decaying exponentials as $x \to -\infty$. W.A.Hepner

530.145

53. SCATTERING OF LONGITUDINALLY POLARIZED FERMIONS WITH ANOMALOUS MAGNETIC MOMENTS. A.M.Bincer.
Phys. Rev., Vol. 107, No. 5, 1467-8 (Sept. 1, 1957).

The effect of a Pauli term on the cross-section is derived, and the results are considered for the neutron—electron, neutron—μ-meson and for the proton—electron, proton—μ-meson systems. W.A.Hepner

530.145

54. HIGH-ENERGY POTENTIAL SCATTERING. Tai Tsun Wu.
Phys. Rev., Vol. 108, No. 2, 466-9 (Oct. 15, 1957).

Asymptotically in the limit of high energies, successive approximations are obtained for the problem of potential scattering where the total phase-shift through the potential is not small. Only the Schrödinger wave-equation is treated. The method consists of first applying the stationary-phase approximation to the integral equation and then solving the resulting equation by iteration to derive the asymptotic behaviour of the field. In particular, some information about the radiation field is obtained. A.

530.145

55. ON THE SOLUTIONS OF THE RADIAL SCHRÖDINGER EQUATION WITH ARBITRARY SPIN. B.Bürgel.
Helv. phys. Acta, Vol. 30, No. 5, 395-406 (1957). In German.

Statement and proof of a general theorem concerning the solutions. P.M.Davidson

530.145

56. ON SCHWINGER'S VARIATIONAL PRINCIPLE. T.W.B.Kibble and J.C.Polkinghorne.
Proc. Roy. Soc. A, Vol. 243, 252-63 (Dec. 24, 1957).

The classical and quantum theories of dynamical systems whose Lagrangians are linear in the coordinate derivatives are studied, with a view to clarifying a number of points in relation to Schwinger's quantum-mechanical variational principle. In particular, linear variations of the dynamical variables are considered, and it is shown that they may be consistently included in Schwinger's formalism. It is also found to be possible to obtain Green's generalized commutation rules by excluding c-number variations from the theory, for a suitably restricted class of Lagrangian. A.

530.162

57. BOSE—EINSTEIN GAS IN A GRAVITATIONAL FIELD. H.A.Gersch.
J. chem. Phys., Vol. 27, No. 4, 928-30 (Oct., 1957).

Taking account of the quantization of the motion in the direction of the gravitational field alters the density of energy levels for the gas particles. The temperature derivative of the chemical potential is discontinuous at the transition temperature, and there results a jump discontinuity in the specific heat at constant volume. A.

530.162

58. NOTE ON THE CANONICAL ENSEMBLE FOR THE IDEAL EINSTEIN—BOSE GAS. J.Ford and T.H.Berlin.
J. chem. Phys., Vol. 27, No. 4, 931-2 (Oct., 1957).

It is shown that the canonical ensemble for the ideal Einstein—Bose gas correctly describes the condensed phase when fully treated by the method of steepest descent. A.

530.162

59. INFORMATION THEORY AND STATISTICAL MECHANICS. II. E.T.Jaynes.
Phys. Rev., Vol. 108, No. 2, 171-90 (Oct. 15, 1957).

For Pt I see Abstr. 5895 (1957). Treatment of the predictive aspect of statistical mechanics as a form of statistical inference is extended to the density-matrix formalism and applied to a discussion of the relation between irreversibility and information loss. A principle of "statistical complementarity" is pointed out, according

to which the empirically verifiable probabilities of statistical mechanics necessarily correspond to incomplete predictions. A preliminary discussion is given of the second law of thermodynamics and of a certain class of irreversible processes, in an approximation equivalent to that of the semiclassical theory of radiation. It is shown that a density matrix does not in general contain all the information about a system that is relevant for predicting its behaviour. In the case of a system perturbed by random fluctuating fields, the density matrix cannot satisfy any differential equation because $\dot{\rho}(t)$ does not depend only on $\rho(t)$, but also on past conditions. The rigorous theory involves stochastic equations in the type $\rho(t) = \mathcal{G}(t,0)\rho(0)$, where the operator $\mathcal{G}$ is a functional of conditions during the entire interval $(0 \rightarrow t)$. Therefore a general theory of irreversible processes cannot be based on differential rate equations corresponding to time-proportional transition probabilities. However, such equations often represent useful approximations. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS

531.55

60. ADDITION TO THE BALLISTIC PENDULUM EXPERIMENT. G.Barnes.
Amer. J. Phys., Vol. 25, No. 7, 452-3 (Oct., 1957).

An addition to the elementary ballistic pendulum experiment (a projectile is fired into a block of wood suspended by strings) is described. The basis of the addition is the use of pump-action pellet gun of accurate bore whose projectile can be fired at a relatively small velocity. By determining the drop of the projectile over a horizontal distance of about 40 ft, its muzzle velocity can be calculated. Comparison of results with those of the usual experiment give rise to errors of 5% less. A.

531.711 : 529.786

THE UNITS OF TIME AND LENGTH. See Abstr. 20

MECHANICS OF FLUIDS

532.13 : 532.584

61. VISCOSITY OF SUSPENSIONS OF UNIFORM SPHERES. J.Happel.
J. appl. Phys., Vol. 28, No. 11, 1288-92 (Nov., 1957).

A mathematical development of the viscosity of suspensions is presented based on the steady-state Stokes—Navier equations of motion omitting inertia terms. The disturbance due to each sphere is assumed to be confined to a frictionless envelope surrounding it similar to the stream tube for flow inside ducts. The relationship obtained between relative viscosity and solids concentration is in good agreement with existing data over a wide concentration range without the necessity of introducing empirical constants. It is thus thought that it may be a suitable model for further theoretical study as well as furnishing a basis for empirical correlation equations of rheological properties. In very dilute systems it does not agree with the well-known Einstein formula, and possible reasons for this variation are advanced. A.

532.14 : 536.513

62. DENSITY OF LIQUID OZONE. R.I.Brabets and J.M.McDonough.
J. chem. Phys., Vol. 27, No. 4, 880-2 (Oct., 1957).

The density of liquid ozone was measured over the range 77.4 to 174.2°K by means of ozone thermometers. The construction of the thermometers and the operating techniques are described. An equation which relates the specific volume of liquid ozone to the absolute temperature is presented. The equation, $V = 0.551 + (6.25 \times 10^{-4})T + (3.35 \times 10^{-6})T^2$, represents the experimental data to within 0.2%. A density of 1.354 ± 0.001 g/ml is reported for liquid ozone at its normal boiling point, 161°K. A.

532.5 : 538.3

63. THE OSCILLATIONS OF AN INFINITE CYLINDER OF GAS WITH INTRINSIC GRAVITATION IN A MAGNETIC FIELD. I.M.Yavorskaya.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 5, 988-90 (1957). In Russian.

Theoretical paper. The problem of the irregular motion of a gas is considered with a basic assumption that the electrical conductivity is high enough for the lines of magnetic force to be "frozen" in the medium. Also discussed are the radial motions of a gas with cylindrical symmetry under the action of Newtonian tension forces and internal magnetic field. The motion of a gas is also considered when velocity varies linearly with distance from the axis of symmetry. C.R.S.Manders

532.517

64. HYDRODYNAMIC THEORY FOR THE FLOW OF A VISCOELASTIC FLUID. Yoh-Han Pao.
J. appl. Phys., Vol. 28, No. 5, 591-8 (May, 1957).

A hydrodynamic theory is formulated and applied. The viscoelasticity is specified in terms of the conventional and well-known relaxation and retardation spectra. Time-dependent recoverable strains are defined with respect to convected rotating coordinate axes. The theory is linear to the extent that these strains are small although the over-all displacement gradients of the fluid may be large. The theory is applied to two-dimensional steady-state simple shear flow to predict the variation of the apparent viscosity and the steady-state elastic compliance with shear rate. Pressure flow through a pipe of circular cross-section has also been treated. Previous work of similar nature is reviewed. A.

532.52

65. TEAPOT EFFECT. J.P.Keller.
J. appl. Phys., Vol. 28, No. 8, 859-64 (Aug., 1957).

When tea is poured from a teapot it often runs along the under side of the spout rather than falling into the cup. Recent experiments have shown that this "teapot effect" is not due to surface tension nor adhesion, as many have supposed. Therefore, a new explanation is presented which is based upon certain exact solutions of the hydrodynamic equations and which seems to account for the effect. In connection with the analysis some new fluid flows with free boundaries are obtained. In addition a method more satisfactory than the usual one is used to study the stability of these flows. See also Abstr. 2070 (1954). A.

532.522 : 541.64

66. END CORRECTIONS IN THE CAPILLARY FLOW OF POLYETHYLENE. E.B.Bagley.
J. appl. Phys., Vol. 28, No. 5, 624-7 (May, 1957).

End corrections n for the capillary flow of some polyethylenes were determined as a function of shear rate G_n. The end-correction term increases slowly at first with log G_n, but as the shear rate approaches the critical value at which the extruded filament becomes rough, both n and dn/d log G_n increase very rapidly. At the critical shear-rate there is an abrupt decrease in dn/d log G_n, and at higher shear rates n increases very slowly with log G_n, with the slope dn/d log G_n being practically constant. All flow curves for a given polyethylene, obtained using capillaries of length to radius ratio ranging from zero to thirty, could be reduced to one single master curve by calculating effective shear-stresses using the appropriate values of the end-correction term n, with no apparent decrease in viscosity even for short capillaries in which the transit time of the polymer is very short. A.

532.612.4 : 532.11

67. THE EFFECT OF PRESSURE ON THE SURFACE TENSION OF LIQUIDS. E.J.Slowinski, Jr, E.E.Gates and C.E.Waring.
J. phys. Chem., Vol. 61, No. 6, 808-10 (June, 1957).

The effect of the pressure of several gases on the surface tensions of water and n-hexane were investigated with the capillary rise method. Pressures up to 100 atm were employed, where possible, with the following gases, He, H_2, N_2, CH_4, CO_2 and C_2H_6. Except for helium, which shows no effect, the surface tensions of the two liquids decrease approximately linearly with increasing gas pressure. At a given pressure the magnitude of the effect increases with increase in critical temperature or boiling point of the gas used. The relative effect is larger for hexane than for water, but the actual change in surface tension is about the same number of dynes/cm for hexane and water. J.Iball

532.64

68. USE OF THE TERM "YOUNG'S EQUATION" FOR CONTACT ANGLES. N.K.Adam.
Nature (London), Vol. 180, 809-10 (Oct. 19, 1957).

It is proposed that the name "Young's equation" to be given to $W_{SL} = \gamma_L(1 + \cos\theta)$ ....(1), rather than, as at present, to $\gamma_S = \gamma_{SL} + \gamma_L \cos\theta$ ....(2). (W_{SL} = work of adhesion, θ = contact angle, γ_L, γ_S and γ_{SL} are the surface tensions of liquid, solid, and solid—liquid surfaces). Eq. (2) which was discovered by Young, is the more important equation because it relates θ to the relative adhesion of liquid to solid and of liquid to liquid.

S.J.Gregg

MOLECULAR THEORY OF LIQUIDS

532.7 : 533.7

69. ON THE THEORY OF BINARY FLUID MIXTURES.
F.J.Pearson and G.S.Rushbrooke.
Proc. Roy. Soc. Edinburgh A, Vol. 64, Pt III, 305-17 (1957).

A number of analogues to the simple fluid compressibility equation are deduced by considering fluctuations in a binary mixture; and their simplest expressions are found to be in terms of the binary-mixture direct correlation functions. The accuracy of these results is tested with the aid of the appropriate extension of the approximate Born—Green theory, which facilitates the demonstration of consistency with the first three terms of the virial expression. The problem of the evaluation of the corresponding radial distribution functions by means of X-ray or optical scattering is taken as far as the determination, in principle, of a concentration correlation function from observations of critical opalescence. A.

532.7 : 533.7

70. EQUATION OF STATE OF GASES AND LIQUIDS AT LOW TEMPERATURES. W.B.Riesenfeld and K.M.Watson.
Phys. Rev., Vol. 108, No. 3, 518-36 (Nov. 1, 1957).

Application of a quantum-mechanical many-particle perturbation method is made to the determination of the equation of state of gases and liquids at low temperatures. The method utilizes the "nearest neighbour" expansion, which is a special case of Brueckner's "linked cluster" expansion. A description is given of condensation, mixed phases, the critical point and the critical temperature. It is shown that even the lowest-order approximation, which involves a relatively simple calculation, yields a physically reasonable theory of these phenomena, as well as the equation of state of the liquid phase. Specific calculations are presented for a system both above and below the critical temperature, and a description of collective phenomena in a quantum-mechanical system is given. The physical basis of the approach rests in a tehcnique for interchanging the order in which averages are taken, and putting "fluctuations" into higher-order terms, which in turn may be handled by the same method. At low temperatures, when the thermal de Broglie wavelength of the particles is large so that they are effectively "spread over large distances", such fluctuations due to particle—particle encounters are expected to be small. A.

532.7

71. ELECTRONIC LEVELS OF A MODEL OF LIQUID POTASSIUM. R.Eisenschitz and P.Dean.
Proc. Phys. Soc. A, Vol. 70, Pt 10, 713-20 (Oct., 1957).

As a one-dimensional model of a liquid a chain of atoms is considered in which the distances of nearest neighbours are independent random variables having a given probability distribution. Electronic levels are derived using the tight-binding approximation. The distribution of quantum states on the energy scale is obtained by applying known results from the mathematics of Jacobian matrices. Using atomic fields appropriate to the potassium atom it is shown that the conducting property of potassium and the insulating property of argon are preserved in the liquid state and that the band structure of the solid state is not essentially changed by the transition from the ordered to the disordered atomic structure. A.

532.7

72. THEORY OF THE EFFECTS OF EXCHANGE ON THE NUCLEAR FINE STRUCTURE IN THE PARAMAGNETIC RESONANCE SPECTRA OF LIQUIDS. D.Kivelson.
J. chem. Phys., Vol. 27, No. 5, 1087-98 (Nov., 1957).

A theory of the influence of exchange forces in liquids upon the nuclear hyperfine structure in paramagnetic "spin resonance" spectra is presented. Formulae are derived for two limiting cases: for the exchange J much larger than the hyperfine separation A, and for $A \ll J$. It is found that as J increases the hyperfine lines broaden (exchange broadening) and start to shift towards the "unsplit" Zeeman frequency. For $J \approx A$, the hyperfine lines have coalesced into a single broad line and for $J > A$ the line narrows (exchange narrowing) about the "unsplit" Zeeman frequency. These calculations are discussed in considerable detail. The effect upon the spectrum of electronic—electronic and electronic—nuclear dipolar interactions and the effect of the rapid molecular motions in liquids are also considered, as well as their interactions with the exchange forces. A.

532.7 : 534.23

73. RELATION OF NUCLEAR SPIN—LATTICE RELAXATION TO ULTRASONIC VISCOUS RELAXATION IN LIQUIDS.
T.A.Litovitz.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 648-53 (May, 1957).

The limitations in the use of the Debye relation for relating the nuclear relaxation time, T_1, to the shear viscosity, η, are emphasized. The possible connection between the correlation time, τ_C, and the shear and volume relaxation times as measured by ultrasonics is investigated. It is shown that τ_C and the average shear relaxation time in glycerol are very close in value. Furthermore, the value of τ_C found for water is very close to the volume relaxation time as calculated from ultrasonic absorption data. By assuming that τ_C is proportional to the shear relaxation time a reasonable explanation of the pressure dependence of T_1 obtained. A.

532.72 : 533.15

74. ENTROPY EFFICIENCY IN THERMAL DIFFUSION.
J.R.White.
Amer. J. Phys., Vol. 25, No. 7, 485-6 (Oct., 1957).

The entropy generation during thermal diffusion is divided into a mixing term (S_m) and a conduction term (S_c). Under certain conditions the ratio S_m/S_c is shown to possess an upper bound — a fact first stated for gases by Onsager. R.O.Davies

532.72 : 533.15

75. A NOTE ON THE DEFINITION OF FLUX OF [THERMAL] DIFFUSION IN BINARY MIXTURES. J.Chanu.
C.R. Acad. Sci. (Paris), Vol. 245, No. 8, 829-31 (Aug. 19, 1957).
In French.

The theories of Prigogine, de Groot, Alexander and others are discussed and compared. H.C.Cole

532.77 : 530.162

76. THEORY OF MULTI-COMPONENT FLUID MIXTURES. II. A CORRESPONDING STATES TREATMENT.
P.J.Wojtowicz, Z.W.Salsburg and J.G.Kirkwood.
J. chem. Phys., Vol. 27, No. 2, 505-14 (Aug., 1957).

For Pt I see Abstr. 7656/1957. The theoretical basis for a theorem of corresponding states for mixtures is examined in a rigorous manner by the use of statistical mechanics. The theorem of corresponding states is found to be a consequence of the following assumptions: (a) the internal molecular partition functions depend only on the temperature, (b) the system is in a condition of random mixing, and (c) the several intermolecular interactions can be described by a set of pair-potentials of the same analytical form. In addition to providing a firm theoretical foundation for the corresponding states treatments of Prigogine et al. and Scott, several new approaches to the use of corresponding states in the statistical thermodynamics of mixtures are also presented. In particular, the chemical potentials in binary mixtures of molecules of equal size, and of unequal sizes, are developed. The coefficients in the Margules expansion of the activity coefficients are found to be expressible as functions of the intermolecular interaction parameters and certain experimentally determined thermodynamic properties of the pure components. The relationships of the Regular solution and Conformal solution theories to the present development are also demonstrated. A.

532.77 : 535.56

77. EFFECT OF THE SOLVENT ON THE OPTICAL ACTIVITY OF THE SOLUTE MOLECULES. V.M.Agranovich.
Optika i Spektrosk., Vol. 2, No. 4, 426-32 (1957). In Russian.

The author attempts to give a theoretical explanation of the effect of the solvent on the optical activity of the solute molecules, based on the results obtained by S.I.Pekar (Zh. éksper. teor. Fiz., Vol. 22, 641, 1952) and A.S.Davýdov (Abstr. 7313/1954), and assuming that (1) there exists no interaction between the solute and solvent molecules, and (2) the solvent is an optically inactive and transparent substance. The method of adiabatic approximation is employed. The author discusses the dispersion of optical activity and its temperature dependence. F.Lachman

532.78

78. TIME LAG IN NUCLEATION. H.L.Frisch.
J. chem. Phys., Vol. 27, No. 1, 90-4 (July, 1957).

A definition for the time lag L in the Zeldovich modified Becker—Döring theory of nucleation is introduced which is in accord with the commonly used definition of L in diffusion theory. This L can be obtained exactly without solving for the transient concentration of

embryos of the new phase. L is found to be the time required to set up the steady-state distribution of embryos from a given initial distribution by means of the steady-state flux of embryos. The numerical evaluation of L from various initial distributions, for at least vapour–liquid transition, exhibits the importance of the homophase fluctuations in the initial embryo distribution in allowing us to observe the transition within the experimental observation time. The implications of this result for the general theory of phase transitions and for "memory" effects in nucleation are discussed. A.

532.783

79. NUCLEAR MAGNETIC RESONANCE STUDY OF LIQUID CRYSTAL TRANSITIONS. W.R.Runyan and A.W.Nolle.
J. chem. Phys., Vol. 27, No. 5, 1081-7 (Nov., 1957).

The spin–lattice relaxation time (T_1) and the transverse relaxation time (T_2) were determined, by the spin-echo nuclear magnetic resonance method, for the isotropic-liquid state of the liquid-crystal compounds p-azoxyanisole (PAA), cholesteryl benzoate, cholesteryl n-butyrate, and cholesteryl propionate. The T_1 values are 1.2 sec for PAA, and 0.06 to 0.15 sec for the cholesteryl compounds. The T_2 values are 0.02 to 0.03 sec for the cholesteryl compounds, and at least 0.05 sec for the PAA. The results are consistent with those for other isotropic liquids. As the temperature decreases toward the transition to the anisotropic phase, a pretransitional decrease of T_2 is observed for the cholesteryl compounds, and a similar decrease of T_1 for PAA. An explanation in terms of Frenkel's theory of heterophase fluctuations is discussed. Thermal expansion curves and interphase surface tension for PAA are also considered, and hysteresis-like behaviour of the phase transition. A.

MECHANICS OF GASES

533.5 : 531.788.7

80. CHARACTERISTICS OF THE BAYARD–ALPERT IONIZATION GAUGE AT PRESSURES ABOVE 10^{-5} mm Hg. G.J.Schulz.
J. appl. Phys., Vol. 28, No. 10, 1149-52 (Oct., 1957).

Bayard–Alpert ionization gauges were calibrated in the range from 10^{-5} to about 10^{-1} mm Hg for various gases. In this pressure range, it is necessary to operate with grid currents below 100 μA in order to minimize the effects of gauge pumping and to prevent space charge from affecting the operation of the gauge. The gauge becomes insensitive to pressure when the ion current reaches 20 to 30% of the electron current. However, linearity is preserved only up to an ion current of about 2% of the electron current. Some of the reasons for the high pressure behaviour of the Bayard–Alpert gauge are discussed. A.

533.5 : 531.788.6 : 621.317.39

81. EXTENDED RANGE THERMAL CONDUCTIVITY VACUUM GAUGE. A.R.Hamilton.
Rev. sci. Instrum., Vol. 28, No. 9, 693-5 (Sept., 1957).

Two magnetic-amplifier circuits for automatically controlling a constant-temperature hot-wire vacuum gauge are described. The differential circuit senses temperature variations by means of voltage and current control coils which respond to the ratio of voltage to current in the hot wire. The bridge circuit senses temperature variations by unbalance in a Wheatstone bridge circuit. In either case, the sensing signal is amplified and fed back to the hot wire in such a direction as to very nearly restore the original temperature. Experimental data are given showing good gauge sensitivity up to 50 mm. A.

533.6.07

82. NEW METHOD OF FLOW VISUALIZATION FOR LOW-DENSITY WIND TUNNELS. R.A.Evans.
J. appl. Phys., Vol. 28, No. 9, 1005-10 (Sept., 1957).

A method is described which employs the absorption by oxygen of radiation in the wavelength region 1400 A to 1500 A. It was developed for use in the low-density supersonic continuous flow wind tunnels at Berkeley because the conventional methods (shadowgraph, schlieren, and interferometer) were predicted to have inadequate sensitivity at the unusually low densities in the test section. A xenon discharge is used for the source of radiation, its 1470 A resonance line being isolated by a calcium fluoride vacuum monochromator. A 26 mm diameter beam of parallel radiation is passed through the test section where it is absorbed more or less depending on the oxygen density along the radiation path. The centre of the test section is then focused by a calcium fluoride vacuum camera on an ultraviolet-sensitive photographic plate. Pictures of shock waves from cylinders $\frac{1}{8}$ and $\frac{1}{4}$ inch in diameter and from a 60° $\frac{3}{8}$ inch wedge were obtained with exposure times of about 4 minutes. Development of a stronger source would reduce the exposure time appreciably. This oxygen absorption method is shown to be suitable, in principal, for general wind tunnel work where the absolute pressures are below about 1 mm Hg. A.

MOLECULAR THEORY OF GASES

533.7

83. HIGHER APPROXIMATIONS FOR THE TRANSPORT PROPERTIES OF BINARY GAS MIXTURES. II. APPLICATIONS. E.A.Mason.
J. chem. Phys., Vol. 27, No. 3, 782-90 (Sept., 1957).

For Pt I see Abstr. 7667 (1957). Detailed numerical calculations are used to test the convergence of the higher approximations for the diffusion coefficient and thermal diffusion factor. The results show Kihara's second approximation to be the best to use and of sufficient accuracy, except for the thermal diffusion factor of mixtures with a heavy component in excess. For such a mixture both the Chapman–Cowling and the Kihara approximations are unreliable, and a new method is proposed for this case. The thermal diffusion of hydrogen–carbon dioxide mixtures is taken to illustrate the possible large errors resulting from use of inaccurate theoretical expressions. For precise work, the first approximations cannot in general be relied upon. A.

533.7

84. MODEL OF NONEQUILIBRIUM ENSEMBLE: KNUDSEN GAS. J.L.Lebowitz and H.L.Frisch.
Phys. Rev., Vol. 107, No. 4, 917-23 (Aug. 15, 1957).

An example of a nonequilibrium ensemble is constructed, a Knudsen gas in a container whose walls are maintained at different temperatures. The approach to a stationary state is investigated, and an interation procedure for find the stationary velocity distribution is derived. An explicit stationary solution is found for the case where a Knudsen accommodation coefficient completely characterizes the effect of gas collisions with the walls. The heat transport is found. A stochastic mathematical model which mimics in certain aspects the above system is investigated. A.

533.7 : 532.7

ON THE THEORY OF BINARY FLUID MIXTURES. See Abstr. 69

533.7 : 532.7

EQUATION OF STATE OF GASES AND LIQUIDS AT LOW TEMPERATURES. See Abstr. 70

533.723

85. DIFFUSION OF PARTICLES WITH MEMORY. P.L.Bender.
Proc. Nat. Acad. Sci. U.S.A., Vol. 43, No. 5, 412-16 (May, 1957).

Particles subject to Brownian motion inside a region R spend various times in a subregion S before being absorbed at the boundary B of R. The distribution of such times is calculated. It appears as an infinite series involving the eigenvalues and eigenfunctions of a certain integral equation. The distribution is of interest in the case of particles which retain some information regarding the time spent in S, e.g. the "memory" may be the orientation of the magnetic moments. L.S.Goddard

533.75 : 534.222.2

86. METHOD OF VERIFYING THE EQUATION OF STATE OF GASES AT HIGH TEMPERATURE. S.S.Semenov.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 4, 841-4 (1957). In Russian.

The ratio of densities in front of and behind a shock wave is derived from measurements of shock-wave angle. Measurements in air and nitrogen are compared with theoretical calculations. Photographs of shock waves in air due to a wedge and a half-wedge are reproduced. R.F.S.Hearmon

VIBRATIONS. ACOUSTICS

534.13

87. COUPLED OSCILLATIONS.
C.R.Kannewurf and H.C.Jensen.
Amer. J. Phys., Vol. 25, No. 7, 442-5 (Oct., 1957).

A method of demonstrating coupled oscillatory motion between physical pendulums using a pair of selsyn motors as the coupling device is described. This type of electrical coupling makes possible the agreement of experimental and calculated values of the normal mode and energy transfer frequencies to better than 1%. Two methods for investigating the coupling as a function of the applied voltage are described and the results presented graphically. A.

534.2

88. THE PROPAGATION OF ELASTIC SHEAR WAVES IN A CRYSTAL TWISTED ABOUT A SPECIAL DIRECTION.
K.S.Aleksandrov.
Kristallografiya, Vol. 2, No. 1, 140-4 (1957). In Russian.

Previous experiments (Abstr. 6957/1957) are analysed mathematically, with special reference to double refraction and polarization of the ultrasonic shear waves. R.F.S.Hearmon

534.22 : 533.7

89. ULTRASONIC DISPERSION IN GASEOUS SULPHUR DIOXIDE. J.D.Lambert and R.Salter.
Proc. Roy. Soc. A, Vol. 243, 78-83 (Dec. 10, 1957).

The velocity of ultrasonic waves has been measured in gaseous sulphur dioxide at 20, 102 and 200°C for values of f/p ranging from 200 kc/s.atm^{-1} to 7 Mc/s.atm^{-1} (f is the ultrasonic frequency, p the pressure). Dispersion involving the major part of the vibrational specific heat was found at all temperatures. Each dispersion zone corresponds to two distinct relaxation times differing by a factor of ten. The lower relaxation time corresponds with activation of the lowest (519 cm^{-1}) vibrational mode, the higher to activation of the remainder of the vibrational energy. The conditions giving rise to a double relaxation process are discussed. A.

534.22 : 539.19

90. CALCULATION OF VIBRATIONAL RELAXATION TIMES IN GASEOUS SULPHUR DIOXIDE. P.G.Dickens and J.W.Linnett.
Proc. Roy. Soc. A, Vol. 243, 84-93 (Dec. 10, 1957).

Approximate vibrational relaxation times have been calculated for gaseous sulphur dioxide at 373°K using the collision theory of Schwartz and Herzfeld (Abstr. 7605/1954). Two major effective relaxation times are found; the shorter associated with the relaxation of the specific heat contribution of the lowest mode and the longer with the relaxation of the total contributions of the two higher modes. The results are compared with the recent ultrasonic dispersion data of Lambert and Salter (see the preceding abstract), a measure of agreement being found. The mechanism of vibrational excitation in gaseous sulphur dioxide is discussed and compared with that in some similar molecules. Tentative predictions are made about the relaxation behaviour of a few selected molecules. A.

534.222.2 : 533.75

SHOCK WAVES IN GASES. See Abstr. 86

534.23

91. SOUND TRANSMISSION THROUGH THIN CYLINDRICAL SHELLS. P.W.Smith, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 721-9 (June, 1957).

An analysis is presented of the impedance presented by a thin cylindrical elastic shell to a pressure or normal stress as a function of the axial wavelength and the angular dependence of the forces. Results of computation are presented graphically. This information is then used to compute a measure of the sound transmitted through the shell immersed in air for various particular cases. The theory of the scattering and absorption of waves incident upon a cylinder at angles other than normal is developed for this purpose. The results and their implications are discussed in detail. A.

534.23 : 532.7

RELATION OF NUCLEAR SPIN–LATTICE RELAXATION TO ULTRASONIC VISCOUS RELAXATION IN LIQUIDS. See Abstr. 73

534.23 : 532.7

92. ULTRASONIC RELAXATION AND THE VIBRATIONAL SPECIFIC HEAT OF LIQUID SULPHUR DIOXIDE.
R.Bass and J.Lamb.
Proc. Roy. Soc. A, Vol. 243, 94-106 (Dec. 10, 1957).

Measurements have been made of the absorption of ultrasonic waves in liquid sulphur dioxide over the range of frequency from 3 to 45 Mc/s and at temperatures of 0, 25 and 50°C. A pronounced relaxation is found, centred about a frequency of approximately 23 Mc/s; this is associated with the time delay in deactivation of two of the three vibrational modes. The mode which does not participate is that of lowest wave-number which is presumed to be responsible for a relaxation at higher frequencies (of the order of 1500 Mc/s). The results are discussed with reference to dispersion measurements in the gas phase. A.

534.23

93. ABSORPTION AND DISPERSION OF FORCED SPHERICAL AND CYLINDRICAL SOUND WAVES ACCORDING TO THE NAVIER–STOKES EQUATIONS. R.P.Kanwal.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 593-5 (May, 1957).

In his classical paper on infinitesimal sound waves in perfect gases endowed with shear viscosity, bulk viscosity and heat conduction, Kirchhoff considered not only plane waves but also a certain class of curved waves. He showed that the absorption and dispersion of these waves is determined by the solution of a biquadratic equation for the complex frequencies, but in discussing the behaviour of particular waves he employed only one of the two pairs of roots, and this he linearized with respect to the driving frequency. The biquadratic itself, as extended by Langevin so as to hold for fluids obeying an arbitrary equation of state, has been solved exactly and generally by C.A.Truesdell (1953). In his comprehensive analysis and interpretation of the solutions, however, Truesdell considered only forced plane waves. In the present article a new version is given of Kirchhoff's approach to curved waves of expansion (an arbitrary motion may be regarded as the vector sum of an isochoric irrotational motion, a set of vorticity waves, and a set of expansion waves. Vorticity waves are not considered. As has been remarked in varying degrees of generality by M.Lessen (1954); Lagerstrom, Cole and Trilling, (1949); S.Jarvis, Jr, (1954); and U.Yao-Tsu Wu (1956) the propagation of linearized vorticity is independent of bulk viscosity and heat conduction) and it is shown how Truesdell's results on plane waves may be adjusted so as to apply to the class of curved waves considered. Spherical and cylindrical waves are analysed in some detail. Proper treatment of this problem requires dimensionless variables and hence some reference standard of length. Two alternatives are considered: (1) the unit of length is a linear dimension of a given oscillator; (2) the unit of length is the wavelength corresponding to the driving frequency according to the theory of nondissipative fluids. In the brief remarks of Kirchhoff, apparently only the first possibility was noticed. For the second class of spherical waves, the absorption coefficient per cm is shown always to be much less than that for the first class. There is a frequency-dependent factor which tends to increase the amplitude with the frequency. Similar analysis is carried out for cylindrical waves, which are shown to behave in a fashion intermediate between plane and spherical waves. A.

534.231

94. A STUDY OF THE ULTRASONIC FIELD IN A LIQUID.
B.Labory and G.Laville.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1401-3 (Oct. 21, 1957). In French.

Following a method of Fox and Rock (1941), the forces on an aluminium cylinder (2 x 2 mm^2) in a sound field from a quartz transducer operating at 1.1, 3.4, 5.6, or 7 kc/s, were determined. That the radiation patterns only agree with theory near the principal maximum, is attributed to non-piston-like movement of the transducer. H.D.Parbrook

534.232 : 621.395.623.7

95. ON THE DIRECTIONAL CHARACTERISTICS OF A CIRCULAR-ARC ARRAY OF ACOUSTIC RADIATORS. K.Feik.
Hochfrequenztech. u. ElektAkust., Vol. 66, No. 2, 29-37 (Sept., 1957). In German.

The quality of a loudspeaker is determined by its linear and nonlinear distortion. The avoidance of linear distortion requires that the directional characteristic of the loudspeaker should be independent of frequency. The author describes a theoretical and experimental investigation of the directional characteristics of circular-arc arrays of sound transmitters as a function of frequency. The cases considered include uncompensated and compensated groups of transmitters, and groups of directional single transmitters arranged on the arc of a circle. Special consideration is given also to the directional characteristics of a semi-circular arrangement of sound radiators. The frequencies used in the experiments cover the range 0.9 to 11.4 kc/s. The directional curves indicate, in

certain arrangements, an almost non-directional characteristic (except perhaps in the backward direction) over the whole frequency-range examined. A.B.Wood

534.232 : 621.395.62

96. ARRAYS WITH CONSTANT BEAM-WIDTH OVER A WIDE FREQUENCY-RANGE. D.G.Tucker.
Nature (London), Vol. 180, 496-7 (Sept. 7, 1957).

In underwater sound-ranging systems hydrophones usually have to be used omnidirectionally because otherwise their beam-width would be inversely proportional to frequency. A solution to the problem of providing directional receivers with a constant effective beam-width over a specified range of frequencies is proposed. Directionality is achieved in all planes using a strip (or line) transducer by coupling with delay lines to produce suitable combinations of $(\sin x)/x$ patterns from each elementary transducer in the strip. For a frequency ratio of $2r + 1$ there must be $2r + 1$ elementary transducers and r delay lines. A typical response curve and schematic diagram for a 19-element array are shown. The method is considered applicable to other listening systems and probably for radio aerial systems as well. K.C.Garner

534.321.9 : 669

97. VIBRATION TREATMENT OF METALS.
H.J.Seemann and H.Staats.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 698-701 (June, 1957).

The treatment of solid and liquid metals by elastic vibrations is discussed. Particular attention is paid to the electrodynamic method in which the alternating field of a coreless induction furnace has a strong static magnetic field superimposed on it, so that the molten metal under treatment, itself becomes the sonic transducer with the production of radially directed vibrations. An expression is derived for the acoustic efficiency of this arrangement. Various special designs are described. A.

534.612 : 551.46.018

98. COMPARISON OF EXPERIMENTAL UNDERWATER ACOUSTIC INTENSITIES OF FREQUENCY 14.5 kc WITH VALUES COMPUTED FOR SELECTED THERMAL CONDITIONS IN THE SEA. F.H.Sagar.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 948-65 (Aug., 1957).

This work had as object the investigation and measurement of direct acoustic fields in shallow surface layers of the sea at short ranges (<1 mile in general) during summer when thermal conditions are complex and changeable; i.e., the correlation of experimental intensities with values computed from thermograms, after steps are taken to (1) minimize signal fluctuations due to transducer-rotations and swell, (2) ensure that direct field intensities only are accepted for analysis, (3) allow for thermal structure change in the relevant layers during recording, and (4) ensure for a few selected experiments that no change occurs in the vertical gradient along the transmission paths during recording. During six weeks in the 1954 summer, 18 experiments performed under calm conditions in depths of 30 to 200 fathoms and in areas about 20 miles from the New Zealand coast, yielded 30 000 values of acoustic pressure. In each experiment the field was sampled simultaneously at 6 depths from 40 to 165 ft, by a "string" of hydrophones, the sampling being repeated at short intervals from 100 up to 1700 yards. The frequency, repetition-rate, and pulse duration were respectively: 14.5 kc/s; 10 per minute; 1.3 msec. During an experiment the projector-depth was constant but values from 40 to 100 ft were used, depending on the temperature gradient encountered. This depth was chosen after inspection of the first of a number of thermograms taken per experiment, the criteria being (1) thermogram simplicity near the projector, (2) estimated relative absence of foci, (3) relative independence of the field upon swell, (4) estimated resolution of the direct and echo pulses at 1000 yards (or more), and (5) minimum downward refraction to ensure adequate signal-to-noise ratios at 1000 yards. These criteria conflict and demand compromise. From each relevant thermogram, intensity anomalies are calculated for points where analysis indicates successful resolution. It is concluded that spatial thermogram constancy was best when both ships were allowed to drift with the currents. It is found that (1) for a few optimum experiments (simple constant thermal structure and small swell) the agreement between the intensity and transmission anomalies was good and gave an attenuation at 14.5 kc/s of (2 to 4) dB per kiloyard. (2) At small ranges (<250 yards) and for large differences in projector and hydrophone depths, large projector directivity correction factors (>3.0) give poor accuracy in the intensity and hence in the transmission anomaly. (3) For gradients producing marked downward refraction and for long ranges, both anomalies are large (10 to 20 dB) and the measurement accuracy of the acoustic pressure is then poor. (Values <1.0 dynes per square centimetre). (4) For the remainder of the 18 experiments, the thermogram-constancy was poor, the swell not negligible, and analysis showed the position of the projector in the gradient to have been not infrequently "unpromising". In general, for such experiments wide variation and poor consistency occurred in the computed attenuation. The conclusion is reached that the discordant and variable values in attenuation obtained in past work at comparable frequencies have been largely the result of swell, of inconstant transducer geometry, of erratic changes in temperature gradient with time and space, and of incomplete resolution between direct and adjacent-path pulses. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.781

99. CONSTANT-RATIO RULE FOR CONFUSION MATRICES IN SPEECH COMMUNICATION. F.R.Clarke.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 715-20 (June, 1957).

Three experiments are reported which give support to an empirical rule which may be used for predicting the entries in a closed confusion matrix for any subset of items drawn from a master set of items with a known confusion matrix. This rule, the constant-ratio rule, states that the ratio between any two entries in a row of a submatrix is equal to the ratio between the corresponding two entries in the master matrix. For this statement of the rule it is assumed that the only variables which differ systematically in obtaining the two matrices are the different sets of messages and the allowable responses. This is an empirical rule which was formulated after examination of three 6 x 6 master matrices for CV's (consonant–vowel syllables) and six 3 x 3 submatrices. Two more experiments using monosyllables and digits were then conducted to test further the rule. Although no direct experimental evidence is reported, the use of the constant-ratio rule for predicting a master matrix given some of its possible submatrices is discussed. A.

534.83 : 614.892

100. ATTENUATION OF EAR PROTECTORS BY LOUDNESS BALANCE AND THRESHOLD METHODS.
J.Hershkowitz and L.M.Levine.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 889-94 (Aug., 1957).

The attenuations of two earmuffs and two earphone sockets were measured by three methods. Two of these methods used a loudness-balance procedure in which the subject, upon removal of the ear protectors, adjusted the ambient sound level to match the loudness to that which existed previously. This procedure was used with half-octave bands of thermal noise in a diffuse sound field and also with pure tones in free-field. The third method was the absolute-threshold-shift method using pure tones in free field and a clinical audiometric procedure. At the low and high frequencies, results of the threshold method indicated an average of six decibels greater attenuation than was measured by the loudness-balance thermal noise diffuse field method. Since the latter method simulates actual usage more closely than the former, it is recommended that a safety factor be applied to threshold results in estimating the protection afforded in high noise ambients by earmuffs and receiver sockets. A.

OPTICS. RADIATION. SPECTRA

535.1

101. INTENSITY MATRIX AND DEGREE OF COHERENCE. H.Gamo.
J. Opt. Soc. Amer., Vol. 47, No. 10, 976 (Oct., 1957).

This letter amplifies the conclusion reached by Gamo (Journal of Applied Physics, Japan, Vol. 25, No. 11, 431-43, 1956) and by Gabor (Information Theory, 3rd London Symposium. London: Butterworth, 1956, 26-33) that the intensity distribution in optical images can be expressed by using positive-definite Hermitian matrices, and shows how the intensity matrix depends on the degree of coherence in the illumination. P.M.Davidson

535.23.08 : 621.317.794

102. STABILITY REQUIREMENTS AND CALIBRATION OF RADIOMETERS WHEN MEASURING SMALL NOISE POWERS. J.C.Greene.
Proc. Inst. Radio Engrs, Vol. 45, No. 3, 359-60 (March, 1957).

A modified Dicke system (Abstr. 2539/1946) is described for radiometers measuring small-noise temperatures, to alleviate the

severe stability requirements. The standard method of operating at an attenuator temperature of about 300°K cannot measure satisfactorily below 0.3°K and to improve this, attenuator temperature ought to be reduced to near 0°K. Another system described involves determining effective aerial temperature to an accuracy matching that wanted from the radiometer. E.D.Hart

535.317.6

103. AUTOMATIC LENS DESIGN METHODS. D.P.Feder.
J. Opt. Soc. Amer., Vol. 47, No. 10, 902-12 (Oct., 1957).

Optical design may be thought of as an exercise in the solution of sets of simultaneous, nonlinear, algebraic equations with prescribed boundary conditions. Several methods for solving such sets of equations are discussed, and numerical examples are given for some of them. These methods are believed suitable for use with automatic computing machinery. In the optical problem there are usually many more equations than variables, so that an exact solution is seldom possible. If, however, the quality of a system is specified by a merit function φ, then a set of parameters which make φ a minimum can be interpreted as a solution of the equations. A.

535.322

104. REFRACTIVE INDEX OF OPAQUE HIGH-GLOSS SURFACES. G.C.Bell, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1118-20 (Dec., 1957).

To measure the refractive index of high-gloss dielectric surfaces, an automatic method for locating Brewster's angle was developed. The measurement is made by using a recording goniophotometer equipped with a special drive linkage for rotating the sample holder at one-half the rate of rotation of the receptor arm. Although developed for index of refraction measurements of paint films, the technique is applicable to any glossy dielectric surface where the angle for specular reflection is well defined. Either opaque or clear films can be measured, but clear films must be applied to depolished black glass or similar surface in order to eliminate specular reflection from the substrate interface. The accuracy of the method is about 0.01 in refractive index. A.

535.327.3 : 539.231

105. DETECTION OF INHOMOGENEITIES IN TRANSPARENT PLASTIC SHEET BY A SIMPLE SCHLIEREN TECHNIQUE. H.H.Allen.
Nature (London), Vol. 180, 50 (July 6, 1957).

Inhomogeneities in a transparent film are made visible by a schlieren system. The film is mounted without cover glasses in a slide projector and a rectangular opaque stop partially covers the front lens. Maximum contrast depends on lens coverage and orientation of the stop with respect to anisotropy of the film. By using polarized incident light and a "Polaroid" stop, information on depolarizing substances is obtained. Examples are given of inhomogeneities and flow-lines in cellulosic film and polythene. E.R.Wooding

535.33.03

106. MERCURY ATOMIC BEAM LAMP. R.L.Barger and K.W.Meissner.
J. Opt. Soc. Amer., Vol. 48, No. 1, 22-7 (Jan., 1958).

The construction and operation of a simple atomic-beam source employing natural mercury is described. Lines of great sharpness are obtained when the emitting beam is viewed perpendicularly to the direction of the flight of the atoms. The Hg^{198} component of the line 2537 A is isolated from the other components by proper selection of the interferometer spacer so that it can be compared with the same line of the Hg^{198} Meggers lamp. This comparison shows that the atomic-beam line is much sharper and that it is feasible to construct an atomic-beam lamp employing a single even isotope of mercury. A.

535.33.07

107. CONSTANTS OF THE HARTMAN FORMULA AND THE CORRECTION CURVE BY I.B.M. CALCULATION. W.F.Koehler and F.K.Odencrantz.
J. Opt. Soc. Amer., Vol. 47, No. 9, 862-3 (Sept., 1957).

Gives an example of the calculation of the correction curve to a Hartman formula extending through the visible spectrum. G.F.Lothian

535.331

108. PRELIMINARY TERM ANALYSIS OF Am I AND Am II SPECTRA. M.Fred and F.S.Tomkins.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1076-87 (Dec., 1957).

Wavelengths of over 3000 americium lines were measured with a 30 ft spectrograph, and intensities compared in a number of sources leading to assignment of most lines as Am I or Am II. Hyperfine structure and isotope shifts were measured in high orders for many lines. In this paper only the classified lines are listed, consisting of 173 Am II lines representing transitions between 5 odd levels and 63 even levels, and 112 Am I transitions between 12 odd levels and 39 even levels. Although the number of classified lines is less than 10% of the total almost all the strong lines are included. The ground states of Am II and Am I are $5f^7 7s$ and $5f^7 7s^2$, respectively. The ionization potential of Am I is 6.0 eV. Most of the levels have not been identified but are believed to be built on $5f^6 6d$ instead of $5f^7$. The binding energy of $5f^7$ compared with $5f^6 6d$ is 10 000 cm^{-1} smaller than in Eu and is related to the higher valences found in the 5f elements compared with the 4f elements. The ratio of the nuclear magnetic moments of Am^{241} and Am^{243} is $\mu_{241}/\mu_{243} = 1.008$. A.

535.331

109. ON THE HYPERFINE STRUCTURE OF THE LINE Hg I λ 5461 A. I.I.Agarbiceanu, N.Ionescu-Pallas and V.Draganescu.
C.R. Acad. Sci. (Paris), Vol. 245, No. 13, 1054-6 (Sept. 23, 1957). In French.

Discrepancies in four previous measurements upon the hyperfine structure of the $(6s7s\,^3S_1 - 6s6p\,^3P_2)$ 5461 A line of Hg I are pointed out and resolved with new measurements. R.W.Nicholls

535.331

110. MODIFICATIONS OF THE Rb EMISSION SPECTRUM DUE TO ATOMIC INTERACTIONS. O.Jefimenko and W.Curtis.
J. chem. Phys., Vol. 27, No. 4, 953-6 (Oct., 1957).

Emission spectra of Rb—rare gas mixtures (Rb—He, Rb—Ne, Rb—A, Rb—Kr, and Rb—Xe) were investigated in search of diffuse bands recently observed in the absorption spectra of Cs and Rb in the presence of foreign gases. In addition to the bands accompanying principal-series lines observed in absorption, a number of new bands (interaction satellites) were found on the long-wavelength side of the Rb lines belonging to the sharp and the diffuse series. The bands accompanying sharp-series lines are very narrow and intense and have the appearance of somewhat broadened spectral lines. The bands at diffuse-series lines are less intense but much wider, and are separated from the atomic lines considerably more than the bands at the sharp-series lines. The bands on the short-wavelength side of the atomic lines were found only at the principal series lines. Extensive continua were observed on the long-wavelength side of the resonance lines and the second doublet of the principal series. At the resonance lines these continua show fluctuations of intensity differing for the various mixtures and cover distances of several hundred wave-numbers. The red bands, the violet bands, and the continua may appear simultaneously and do not require different operating conditions for their observation. A.

535.331

111. NEW LINES IN THE SPECTRA OF ZIRCONIUM. W.E.W.Howe.
J. Opt. Soc. Amer., Vol. 48, No. 1, 28-30 (Jan., 1958).

Two hundred twenty-four new atomic zirconium lines are found in the region between 6100 and 6500 A. Fifty-four are attributed to transitions between previously determined terms of neutral zirconium, Zr I. One is attributed to known terms of singly ionized zirconium, Zr II. A.

535.333

112. RESEARCHES UPON THE EMISSION OF A NUMBER OF GASES UNDER HIGH PRESSURE. S.Weniger.
Ann. Phys. (Paris), Vol. 2, No. 5-6, 369-418 (May-June, 1957). In French.

In this extensive spectroscopic study of the radiations from discharges through compressed gases observations were made upon: (1) Stark-broadening of the Balmer series in H_2; (2) Emission of the auroral green line of O and the Schumann—Runge and Atmospheric band-system of O_2; (3) Emission of the First Positive band-system of N_2; (4) Emissions from the rare gases; (5) Emission from metal vapours in high-pressure carrier gases. R.W.Nicholls

535.333

113. FLAME SPECTRA OF METAL COMPOUNDS IN THE INFRA-RED. A.Lagerqvist and L.Huldt.
Ark. Fys., Vol. 12, Paper 21, 491-4 (1957).

Salts (usually chlorides) of Ba, Cu, La, Ti, V, Cr, Mn, Fe, Co and Ni were sprayed into an acetylene/air flame. Small-dispersion traces of the spectra were made from 1 to 15 μ. Flame bands of H_2O and CO_2 cause interference and no metallic bands are observed beyond 3.6 μ. There are indications of bands of CrO, MnO, FeO and VO in the near infrared. A.G.Gaydon

535.333

114. ROTATIONAL ANALYSIS OF THE TANTALUM OXIDE BANDS. D.Premaswarup and R.F.Barrow.
Nature (London), Vol. 180, 602-3 (Sept. 21, 1957).

A new analysis of bands of the A and C systems is carried out: the systems have their lower state, $a\,^2\Delta$, in common. r_e'' is found to be 1.687 A. R.F.Barrow

535.333

115. BANDS Id AND IId OF NH_2 OBSERVED IN THE SPECTRUM OF AMMONIA. P.Proisy.
C.R Acad. Sci. (Paris), Vol. 244, No. 23, 2784-5 (June 3, 1957). In French.

A comparison is made between bands of NH_2 excited in the laboratory and in comets. It is proposed that the 4718 A band may also be present in cometary spectra although partially obscured by the Swan bands of C_2. R.W.Nicholls

535.338.334 : 538.566

116. ON THE QUESTION OF NATURAL LINE-WIDTH IN THE RADIOFREQUENCY REGION. V.M.Faĭn.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 607-8 (1957). In Russian.

Extends the work of Dicke (Abstr. 3248/1954) on the natural spectroscopic line-width of an assembly of gas molecules in a vessel smaller than the wavelength of the radiation. In thermal equilibrium without special coherence the intensity of emission is given by $I = I_0 nE/2kT$ where n is the number of molecules, E the transition energy and I_0 the intensity of spontaneous emission of one isolated molecule. The line width is $\gamma = \gamma_0 nE/2kT$, with γ_0 the line-width for an isolated molecule. D.H.Whiffen

535.343 : 541.124

117. INFRARED SPECTROSCOPY AND CHEMICAL REACTIVITY. M.L.Josien.
Cahiers de Phys., Vol. 11, 49-58 (Feb., 1957). In French.

A general discussion.

535.343

118. VIBRATIONAL SPECTRA OF MOLECULES AND COMPLEX IONS IN CRYSTALS. X. H_2S AND D_2S. F.P.Reding and D.F.Hornig.
J. chem. Phys., Vol. 27, No. 5, 1024-30 (Nov., 1957).

For Pt IX see Abstr. 6001 (1957). The infrared spectra of H_2S in phases III, II, and I were studied at 66, 112, and 140°K, respectively. That of D_2S was studied in phase III at 66°K. The spectra of phase III consist of extremely sharp lines and the structure must be ordered, probably with eight molecules in a primitive unit cell of symmetry D_{4h}. The stretching bands in the spectra of phases II and I are broader and indicate a disordered arrangement of the hydrogen atoms. The structure of the crystal in phase III is discussed. The crystal spectra indicate that the fundamental frequencies in gaseous D_2S must be very nearly $\nu_2 = 855$ cm^{-1} $\nu_3 = 1910$ cm^{-1}. A.

535.343

119. INFRARED SPECTRA OF MOLECULES WITH HYDROGEN BONDS. S.Bratož and D.Hadži.
J. chem. Phys., Vol. 27, No. 5, 991-7 (Nov., 1957).

The unusual features of the infrared spectra of molecules with hydrogen bonds are discussed. It is shown that the broad hydrogen stretching bands associated with strong hydrogen bonds are not single bands, but groups of bands which are very sensitive to intermolecular influences. This is due to the anharmonicity of some parts of the (effective) molecular potential energy surface. This surface occasionally has two minima which implies typical double minimum phenomena. Variations in the intensity of the hydrogen stretching bands in going from the nonbonded to the bonded molecules is discussed and an explanation attributing this variation to the charge transfer associated with the hydrogen bond formation is offered. A.

535.343 : 535.375.5

120. RAMAN AND INFRARED INTENSITIES IN THE VIBRATIONAL SPECTRA OF HYDROCARBONS. II. THE CH VIBRATIONS OF STRAIGHT n-PARAFFINS. O.Theimer.
J. chem. Phys., Vol. 27, No. 5, 1041-8 (Nov., 1957).

For Pt I see Abstr. 9618 (1957). The Raman and infrared intensities of the CH vibrations of solid n-paraffins are analyzed theoretically. The dependence of the relative intensity I of bands on the number N of C atoms is investigated experimentally. An empirical relation of the form $I = AN^p + BF(N)$, where $A \gg BF(N)$, $p = 0$ for factor group modes, $p = -1$ for terminal modes, and $-3 < p < 1$ for "inactive" modes, is found and confirmed by the theory. The intensities of 5 infrared active factor group modes are calculated from 3 independent parameters only, in agreement with experiment. One of the parameters is the permanent CH-bond moment whose magnitude is found to be 0.085 ± 0.02 debye. The relative intensities of the Raman-active twisting, wagging, and rocking modes are determined theoretically; one finds approximately: $I_{tw} : I_w : I_r = 6 : 3 : 1$. This supports previous assignments. A.

535.343 : 535.375.5

121. INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHANES. IX. 1,1,1-TRIFLUORO-2-CHLORO-2-BROMOETHANE. R.Theimer and J.R.Nielsen.
J. chem. Phys., Vol. 27, No. 4, 887-90 (Oct., 1957).

For Pt VIII see Abstr. 9086 (1957). The infrared absorption spectrum of gaseous 1,1,1-trifluoro-2-chloro-2-bromoethane was obtained with a 1 cm cell and a double-pass spectrometer equipped with CsBr, NaCl, and LiF prisms. The Raman spectrum of the liquid phase was photographed with a 3-prism glass spectrograph of reciprocal linear dispersion 15 A/mm at 4358 A. The 18 vibrational fundamentals are assigned as follows: 72, 160, 202, 229, 310, 364, 520, 552, 665, 718, 814, 863, 1133, 1179, 1198, 1273, 1313, and 3017 cm^{-1}. The four lowest are for the liquid state, the others for the gas. The spectra are interpreted in detail. Thermodynamic functions are calculated. A.

535.343 : 535.375.5

122. INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHANES. X. 1,1,1-TRIFLUORO-2-BROMOETHANE. J.R.Nielsen and R.Theimer.
J. chem. Phys., Vol. 27, No. 4, 891-5 (Oct., 1957).

The spectra of CF_3-CH_2Br were obtained with the instruments described in the preceding abstract, and depolarization ratios were measured for all but 2 of the Raman bands. The 18 vibrational fundamentals are assigned as follows: species a' : 3000, 1311, 1251, 1083, 850, 844, 725, 634, 526, 312, and 158 cm^{-1}; species a'' : 3052, 1437, 1282, 1143, 539, 352, and 104 cm^{-1}. The spectra are interpreted in detail. Thermodynamic functions are calculated. A.

535.343

123. THE CHARACTERISTIC FREQUENCIES OF NEGATIVE MOLECULAR IONS OF OXYGEN BETWEEN 3 AND 13 Mc/s OBSERVED IN IONIZED AIR DISCHARGE TUBES. T.V.Ionescu and O.C.Gheorghiu.
C.R. Acad. Sci. (Paris), Vol. 245, No. 9, 898-901 (Aug. 26, 1957). In French.

Previous absorption measurements by one of the authors are extended to pressures between 10^{-2} and 10^{-3} mm Hg and frequencies 2 to 15 Mc/s. Strong absorption related to rotational quantum numbers K = 10 and 11 is observed. Below 5 Mc/s, absorption is weaker and calculated frequencies of 2.97, 3.39 and 4.37 Mc/s are noted. A.E.D.Heylen

535.343 : 538.615

124. RADIO-FREQUENCY ZEEMAN EFFECT IN O_2. J.M.Hendrie and P.Kusch.
Phys. Rev., Vol. 107, No. 3, 716-23 (Aug. 1, 1957).

The molecular-beam magnetic resonance method was used to study the Zeeman effect of the rotational states of O_2. The ratio of the g-value of the rotational magnetic moment to that of the electron-spin moment was found to be $g_K/g_S = +(6.08 \pm 0.74) \times 10^{-3}$. The ratio of the g-value of the unpaired-electron spin moments in O_2 to that of the free-electron spin moment was found to be $g_S(O_2)/g_S(\text{free}) = 1 - (190 \pm 13) \times 10^{-6}$. A.

535.343

125. J = 3, K = 2 LINE IN THE INVERSION SPECTRUM OF $N^{14}H_3$. G.F.Hadley.
Phys. Rev., Vol. 108, No. 2, 291-3 (Oct. 15, 1957).

The coupling scheme used by Gunther-Mohr (Abstr. 7303-4/1954) to study the hyperfine structure in the spectrum of $N^{14}H_3$ breaks down when there is no first order quadrupole splitting, i.e., for J = 3, K = 2. This occurs because to neglect matrix elements off diagonal F_1 it is necessary to have a quadrupole splitting considerably larger than the other interactions being considered. This special case is treated here by including the elements off-diagonal in F_1. The energy splittings, frequencies, and relative intensities are found. The numerical constants used in the evaluation are taken from the work of Gordon (Abstr. 8625/1955). It should be possible to observe the details of this line with the maser. A.

535.343 : 539.19

126. MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT, AND QUADRUPOLE COUPLING CONSTANTS OF FORMAMIDE. R.J.Kurland and E.B.Wilson, Jr.
J. chem. Phys., Vol. 27, No. 2, 585-90 (Aug., 1957).

The microwave spectra of formamide, and the isotopic species,

1, 2 N di-deutero formamide, 1 N mono-deutero formamide (cis) and (trans), were investigated. The rotational constants obtained from the frequencies of assigned rotational transitions lead to the following effective structural parameters: for the bond distances, there results C—O = 1.243 ± 0.007 A, C—N = 1.343 ± 0.007 A, N—H = 0.995 ± ± 0.007 A, and for the bond angles ∠HNH = 118.98 ± 0.50°, ∠NCO = 123.58 ± 0.35°, ∠NCH = 103.9 ± 1.2°. The molecule is planar. Stark effect measurements yield values for the dipole moment components which, when combined with assumed approximate bond moments and the structural parameters, give the magnitude and the direction of the dipole moment. The dipole moment is thus equal to $3.71_4 \pm 0.06$ debye and makes an angle of 39.6° with the C—N bond. The quadrupole coupling constants, $\chi_a = 1.9$ Mc/s, $\chi_b = 1.7$ Mc/s, $\chi_c = -3.6$ Mc/s, were calculated from the frequency shifts of the hyperfine splittings observed for several rotational transitions. The structural parameters and quadrupole coupling constants are discussed in terms of the bonding characteristic of the N—C—O linkage in formamide and related compounds. A.

535.343

127. MICROWAVE SPECTRA OF MOLECULES EXHIBITING INTERNAL ROTATION. I. PROPYLENE.
D.R.Lide, Jr and D.E.Mann.
J. chem. Phys., Vol. 27, No. 4, 868-73 (Oct., 1957).

The microwave spectrum of propylene, $CH_3CH{:}CH_2$, was investigated in the region 17-36 kMc/s. Measurements were made on the normal isotopic species and on the $H_3CC^{13}H{:}CH_2$ species. Most of the observed lines are split slightly as a result of internal rotation. These splittings were satisfactorily analysed by the methods of Hecht and Dennison, giving an internal potential barrier of 692.4 ± 6 cm^{-1} or 1978 ± 17 cal/mole. Principal moments of inertia (in units of a.m.u. A^2) are 10.973, 54.312, and 62.175 for $H_3CCH{:}CH_2$ and 11.160, 54.318, and 62.382 for $H_3CC^{13}H{:}CH_2$. The electric dipole moment has a magnitude of 0.364 D and makes an angle of 8° with the a principal axis. With reasonable assumptions concerning the location of the hydrogen atoms the remaining structural parameters are: $r_{CC} = 1.488$ A, $r_{C:C} = 1.353$ A, ∠CCC = 124°45'. A.

535.343

128. MICROWAVE SPECTRA OF MOLECULES EXHIBITING INTERNAL ROTATION. II. METHYLALLENE.
D.R.Lide, Jr and D.E.Mann.
J. chem. Phys., Vol. 27, No. 4, 874-7 (Oct., 1957).

For Pt I see preceding abstract. The microwave spectrum of methylallene, $CH_3CH{:}C{:}CH_2$, was investigated in the region 16-33 kMc/s, and the J = 1 → 2, 2 → 3, and 3 → 4 transitions measured. Most of the observed lines are split slightly as a result of internal rotation. Analysis of the splittings by the methods of Hecht and Dennison leads to an internal potential barrier of 556.0 ± 2 cm^{-1} or 1589 ± 6 cal/mole. The principal moments of inertia (in units of a.m.u. A^2) are 14.93, 120.321, and 128.713. The electric dipole moment is 0.401 D and makes an angle of 10°8' with the a principal axis. A.

535.343

129. THE MICROWAVE SPECTRUM OF METHYL ALCOHOL.
H.G.Fitzky and H.Happ.
Z. Naturforsch., Vol. 11a, No. 11, 957-8 (Nov., 1956). In German.

Detailed measurements were made from 7600-10 000 and 15 200-19 200 Mc/s. For two lines only was it possible to analyse the type of transition, using Dennison's theory that the total rotation energy is approximately the sum of the rotation energy $E_{J,K}$ of the symmetrical top and the energy $E_{K,\tau,n}$ of the restricted rotation. J.Jacobs

535.343.9 : 535.375.5

130. INTENSITY AND WIDTH OF THE RAMAN LINES OF BENZENE AND CARBON DISULPHIDE.
R.Mierzecki and N.I.Rezaev.
Bull. Acad. Polon. Sci., Cl. 3, Vol. 5, No. 6, 643-8 (1957).

Measurements of Raman line peak intensities, integrated intensities and shapes were made for C_6H_6 and CS_2 with a DFS-4 Soviet diffraction grating spectrometer with photoelectric detection. Agreement is obtained with earlier work with photographic detection, and with theory. D.H.Whiffen

535.343.9 : 535.375.5

131. THE RAMAN SPECTRUM OF CALCITE AND ITS INTERPRETATION. D.Krishnamurti.
Proc. Indian Acad. Sci. A, Vol. 46, No. 3, 183-202 (Sept., 1957).

Both the observed principal Raman shifts and their weaker satellites are discussed in detail. Results are graphically and photographically presented. G.I.W.Llewelyn

535.361.2

132. AUTOMATIC RECORDING REFLECTOMETER FOR MEASURING DIFFUSE REFLECTANCE IN THE VISIBLE AND INFRARED REGIONS. W.L.Derksen, T.I.Monahan and A.J.Lawes.
J. Opt. Soc. Amer., Vol. 47, No. 11, 995-9 (Nov., 1957).

A reflectometer was constructed for the purpose of measuring the diffuse reflectance of living tissue and inert materials for visible and infrared radiation. Appreciable energy from the sources generally employed in studies of the effects of intense thermal radiation on materials falls in the infrared region between 1.0 and 2.8 microns. The reflectometer consists of a 6 in. diameter aluminized-glass hemispherical collecting mirror and a flat $\frac{3}{4} \times \frac{3}{4}$-inch lead sulphide photocell receiver. A monochromator is employed as the dispersing unit. A beam-splitting chopper, placed between the monochromator and reflectometer, permits the use of a reference or monitor receiver to control the slit opening and thus the radiant energy to the reflectometer. The wavelength range for automatic scanning is from 0.5 to 2.7 microns. The recorder traces are not direct-reading, but must be corrected for differences in the spectral response of the signal and reference photoconductive cells and the reflectance standard and that of the hemisphere. A.

535.37 : 535.343

133. THE LUMINESCENCE OF TERVALENT URANIUM.
L.N.Galkin and P.P.Feofilov.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 4, 745-7 (1957). In Russian.

Crystals of CaF_2, SrF_2, and BaF_2 grown under strongly reducing conditions with 0.1-0.3% U were intensely coloured (showing numerous strong absorption bands extending from the ultraviolet to beyond 2 μ) and also luminesced in the region 2.0-2.5 μ. Long-wavelength absorption and luminescent spectra varied little between the three materials; absorption spectra at shorter wavelengths, however, did show differences. Reasons for ascribing these effects to the presence of tervalent uranium are given; the electronic transitions involved are briefly discussed. C.H.L.Goodman

535.37

134. ZINC BORATE PHOSPHORS AND THEIR LUMINESCENT PROPERTIES. Yu.S.Leonov.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 5, 976-9 (1957). In Russian.

The luminescence of phosphors in the $ZnO-B_2O_3$ system was found to be determined by that of two compounds: $ZnO.B_2O_3$ and $3ZnO.B_2O_3$ (see D.F.Harrison and F.A.Hummel, J.Electrochem. Soc., Vol. 103, No. 9, 491-8, 1956). Luminescence and thermoluminescence curves for various Mn-activated phosphors are given. The reactions by which such phosphors form were studied by differential thermal analysis. C.H.L.Goodman

535.371

135. A METHOD OF ACCURATE DETERMINATION OF THE RELATIVE YIELD OF THE FLUORESCENCE OF SOLUTIONS.
R.Bauer and D.Frąckowiak.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 7, 729-32 (1957).

The concentration of one solution is adjusted so that its absorption coefficient for the incident light is the same as that of the second solution. Under these conditions, the ratio of the fluorescence intensities is equal to the relative fluorescence efficiency. Corrections for spectral shifts, scattering, self-quenching, and polarization effects are considered. J.B.Birks

535.371

136. FURTHER INVESTIGATIONS ON THE DECAY OF PHOSPHORESCENCE OF RIGID SOLUTIONS. M.Frąckowiak.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 8, 809-12 (1957).

Jabłonski's theoretical expression for the phosphorescence decay of isotropic rigid solutions is compared with experimental decay curves for acridine yellow and acridine orange in gelatine. The radii of the active spheres are thus determined, and they are found to be practically independent of concentration. J.B.Birks

535.371

137. FLUORESCENT LIFETIMES OF URANYL SALTS AT DIFFERENT TEMPERATURES. L.A.Hall and G.H.Dieke.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1092-6 (Dec., 1957).

The decay of the fluorescence of uranyl salts was measured at 293°, 77°, and 4°K with a photoelectric gate circuit technique. The resultant mean lives of the excited states in general increase sharply with decreasing temperatures. This indicates that at the higher temperatures where relaxation times as low as 50 microseconds are found the upper states are destroyed chiefly by interaction with the crystal lattice. The lifetime of the undisturbed UO_2 ion must be more than 2 milliseconds. This is in agreement with the brightness of the fluorescence which normally increases in proportion with the mean life. A.

535.371

138. SULFUR VACANCY EMISSION IN ZnS PHOSPHORS. N.T.Melamed.
Phys. Rev., Vol. 107, No. 6, 1727-8 (Sept. 15, 1957).

Emission with a peak at 3950 A was found at 77° K in samples of ZnS probably containing sulphur vacancies. The emission corresponds to van Gool's reported emission band at 6200 A in CdS:Ag. It is considered that in both phosphors the vacancies act as donor states in the sense of Lambe and Klick's model, while acceptor states may also arise from Cu or Ag atoms, as described by Schön and Klasens. S.T.Henderson

535.372 : 536.48

139. LUMINESCENCE OF SINGLE CRYSTALS OF RED HgI_2 AT VERY LOW TEMPERATURES. M.Sieskind.
C.R. Acad. Sci. (Paris), Vol. 245, No. 12, 1006-9 (Sept. 16, 1957). In French.

Luminescence emission spectra of red HgI_2 single crystals, excited at low temperatures (1.5-77°K), consisted of lines and bands between 5000 and 6300 A. The emission spectra perpendicular to the crystal axis differed from those parallel to the axis; this effect is probably related to the dichroism of the absorption spectra. J.Franks

535.372

140. LUMINESCENCE OF BENZENE AND HEXADEUTERO-BENZENE AT 20°K. A.Zmerli.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1911-13 (Nov. 25, 1957). In French.

The vibrational structure of the luminescence spectrum of benzene at 20° K is due to vibrational levels of excited states. The effect may be caused by the photochemical action of oxygen. J.Franks

535.377

141. THE INFLUENCE OF THE WAVELENGTH OF EXCITING LIGHT AND OF THE NATURE OF TRAPPING LEVELS IN ZnS:Cu:Co PHOSPHORS ON TRAPPING LEVEL OCCUPATION. V.L.Levshin and V.F.Tunitskaya.
Optika i Spektrosk., Vol. 2, No. 3, 350-4 (1957). In Russian.

Continuation of work described in Abstr. 4240/1957. Thermoluminescence curves (T) for phosphors ZnS:Zn, ZnS:Cu, ZnS:Cu:Co, and ZnS:Cu (fired in H_2S), were determined for increasing excitation by 312, 366 or 436 mμ radiation. Of three sets of levels observed with ZnS:Cu:Co the deepest appeared preferentially filled for any excitation time by 436 mμ radiation, for short and medium times by 366 mμ, and for long by 312 mμ. Maximum light sum was obtained (for all the above phosphors) on prolonged excitation by 366 mμ radiation. The effect on T for ZnS:Cu:Co of mixed (i.e. 366 mμ plus 436, ~ 800, or ~ 1300 mμ) excitation was also studied. The shallower traps tended to be emptied, and in certain cases electrons from them could be transferred to the deepest traps, which even with maximum (single-wavelength) excitation appeared incompletely filled. C.H.L.Goodman

535.43

142. NEW TABLES OF TOTAL MIE SCATTERING COEFFICIENTS FOR SPHERICAL PARTICLES OF REAL REFRACTIVE INDEXES ($1.33 \leq n \leq 1.50$). R.B.Penndorf.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1010-15 (Nov., 1957).

Extensive computations of the total Mie scattering coefficient K were carried out using an I.B.M. electronic data processing machine. The detailed results show very clearly the nature as well as the complexity of the scattering coefficient. K was computed for size parameters $0 \leq \alpha \leq 30$ in steps of $\Delta\alpha = 0.1$ and for 5 indexes of refraction n = 1.33, 1.40, 1.44, 1.486 and 1.50. The results of the computations considered correct to 5 significant figures are listed in tables and displayed in figures. A.

535.514.4

143. THE COMPOUND POLARIZER. M.A.MacConaill.
Nature (London), Vol. 180, 603 (Sept. 21, 1957).

This is a device for producing beams of polarized light of variable colours in the field of a microscope ocular. It consists of a disk of "Polaroid", a disk of polythene, and a disk of "Rayophane", in that order from the light source. The construction and mode of action are described. The device enables "optical sectioning" of anisotropic material in an anatomical specimen to be carried out. H.G.Jerrard

535.543

144. EXPERIMENT ON THE SENSITIVE COLOR. H.Kubota and K.Shimizu.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1121-3 (Dec., 1957).

When the polarization colour produced by white light passing through a thin crystal plate placed between Nicols is purple, the change of colour according to the change of thickness of the plate is very sensitive and purple is therefore known as the "sensitive colour". The existence of a more sensitive colour in the case of crossed Nicols, predicted theoretically by one of the authors, is confirmed quantitatively by experiment. The observed value of the ratio of sensitivity agrees well with the value calculated by using the N.B.S. unit of colour difference based on the α, β-U.C.S. diagram. A.

535.56 : 532.77

EFFECT OF THE SOLVENT ON THE OPTICAL ACTIVITY OF SOLUTE MOLECULES. See Abstr. 77

535.65 : 628.93

145. EXPERIMENTAL STUDIES MADE BY TARNAY AND BARTHÈS TO PERFECT A METHOD OF FINDING THE COLOUR POINT FOR THE LIGHT RECEIVED ON THE WORKING PLANE IN A ROOM WITH COLOURED WALLS. E.Barthès.
Bull. Soc. Franç. Elect., Vol. 7, 546-52 (Sept., 1957). In French.

Describes experiments in a model room in which the walls could be covered with papers of various colours, the ceiling being always white. By the use of a specially designed colorimeter, the colour of the light from a given lamp after one and after two reflections from any of these coloured papers could be measured. The colour of the light reaching the working plane was then calculated by an approximate formula and the results were found to agree satisfactorily with measurements made in the model. J.W.T.Walsh

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.89

146. SIMPLE SUBMICROSECOND LIGHT SOURCE WITH EXTREME BRIGHTNESS. H.Fischer.
J. Opt. Soc. Amer., Vol. 47, No. 11, 981-4 (Nov., 1957).

Maximum brightness of approximately 40 million candles/cm² with 0.25 μsec half-width or shorter is obtained in a capacitor-discharge with open air gap in which a toroidal capacitor surrounds the gap coaxially. A method for absolute brightness measurement is described. A.

HEAT

536.212 : 536.631

147. EFFECT OF IODINE ON THE THERMAL CONDUCTIVITY OF SELENIUM. G.B.Abdullaev and M.I.Aliev.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 5, 995-6 (1957). In Russian.

Curves connecting the iodine content (up to about 1.5%) with thermal conductivity in amorphous and crystalline selenium are given. The conductivity of the crystallized form is higher, but both forms show a minimum conductivity at about 0.3% iodine content. The heat capacity (c) of both forms is independent of iodine content. For crystalline selenium, $c = 0.0701$ cal gm^{-1} deg^{-1} and for amorphous selenium $c = 0.118$ cal gm^{-1} deg^{-1}. R.F.S.Hearmon

536.33.08 : 621.317.794

148. BOLOMETERS FOR RADIATION MEASUREMENT. G.Barth.
Arch. tech. Messen, No. 260 (Ref. J23-3), 201-4 (Sept., 1957). In German.

A review of the characteristics and construction of bolometers and their application to measurement of infrared radiation. Some circuit arrangements are given which include rotating slotted disks for beam chopping to permit use of a.c. amplifiers. There are 28 references. C.F.Pizzey

536.413 : 536.48

149. LOW-TEMPERATURE THERMAL EXPANSION OF COPPER. R.O.Simmons and R.W.Balluffi.
Phys. Rev., Vol. 108, No. 2, 278-80 (Oct. 15, 1957).

A rotating single-crystal back-reflection X-ray diffraction technique was used to measure the thermal expansivity of copper. Values of the linear thermal expansion coefficient are derived at low temperature where disagreement exists in the literature. A possible decrease in the Grüneisen parameter γ for copper exists near 40°K. The decrease reported in the present work is much less marked than previously reported from capacitor dilatometer work, however. It is suggested that large apparent decreases in γ at low temperature reported from similar measurements on Al, Fe, Ag, and KBr may be in error. A.

536.48

150. ABSOLUTE TEMPERATURES BELOW 1° K: CHROMIC METHYLAMMONIUM ALUM AS A THERMOMETRIC SUBSTANCE. E.Ambler and R.P.Hudson.
J. chem. Phys., Vol. 27, No. 2, 378-89 (Aug., 1957).

The method of gamma-ray calorimetry was employed to determine the entropy–temperature relation for a single-crystal of chromic methylammonium alum in the range 0.015°-1° K. A critical discussion of possible sources of error is given; the accuracy in T is estimated to be approximately 5% throughout the region investigated. There is close agreement between the Hebb–Purcell theoretical S-T relation and the present data down to 0.07° K. The fact that the susceptibility–entropy relation varies considerably for different specimens at temperatures below 0.06° K suggests that S-T measurements are of limited value in that region, especially from a thermometric point of view. A.

536.48

151. TWO-FLUID MODEL AND SOUND ABSORPTION IN HELIUM II. W.Czaja.
Helv. phys. Acta, Vol. 30, No. 5, 447-56 (1957). In German.

The assumptions of the two-fluid model of He II according to Prigogine and Mazur (Abstr. 8695/1951) are explained and calculations reported which treat with this model the oscillations of He II in a spherical resonator. Eigen-frequencies and absorption coefficients are given and the spacial velocity distribution is discussed.

H.London

536.48

152. MEASUREMENT OF THE PRODUCT OF VISCOSITY AND DENSITY OF LIQUID HELIUM WITH A TORSIONAL CRYSTAL. B.Welber and S.L.Quimby.
Phys. Rev., Vol. 107, No. 3, 645-6 (Aug. 1, 1957).

The product of the viscosity and the density of liquid helium in the range 1.3°-4.2° K was measured with a quartz crystal cylinder performing torsional oscillations at 32.4 kc/s. The measurements were found to be independent of velocity over a wide range. A.

536.48

153. ELEMENTARY THEORY OF LIQUID HELIUM: REFINEMENT OF THE THEORY AND COMPARISON WITH FEYNMAN'S THEORY. O.K.Rice.
Phys. Rev., Vol. 108, No. 3, 551-60 (Nov. 1, 1957).

It has been suggested that the excitations of liquid He^3 can be represented approximately as excitations of pairs of helium atoms acting as hindered plane rotators. For the low excitations N helium atoms may be considered as N/2 pairs; for the higher excitations the possibility of random pairing must be taken into account, a situation which is discussed in some detail. Because of fluctuations in the hindering potential, and because of interactions between localized excitations, the energy levels of the plane rotators are broadened into energy bands, which can give a good account of the specific-heat curve. The multiplicity of these levels is related on the one hand to the statistics and spin of He^3 atoms, and on the other to the vibrational modes of a quasi-lattice approximating the liquid, and is also concerned with the development of communal entropy in a quantum liquid. In He^4 the low-lying energy levels are excluded because of the spin and the statistics. Vibrations of single atoms, pair rotators, and double pairs, rotating or oscillating like meshed gears, have excitation energies close to that of a roton (the energies of the latter two types are estimated by comparison with He^3, allowing for the effect of the increased density on the hindering potential). These types of excitation are not all independent, however, and there is moderate difficulty in accounting for the multiplicity of the excitations as deduced empirically from the number of rotons appearing at different temperatures, which is obtained reasonably accurately from the specific heats. The picture presented here is compared with Feynman's theory; it concluded that there is good correspondence — even the difficulty concerning the multiplicity of the excitations being present in both cases. The relation of a broadened band of energy levels to the idea of a gas of excitations is considered, and it is concluded that such a gas should obey Fermi–Dirac statistics. A.

536.48

154. MUTUAL FRICTION IN A HEAT CURRENT IN LIQUID HELIUM II. III. THEORY OF THE MUTUAL FRICTION. W.F.Vinen.
Proc. Roy. Soc. A, Vol. 242, 493-515 (Nov. 19, 1957).

As was shown in Pt II (Abstr. 6121/1957), the Gorter–Mellink mutual friction force in a heat current is probably associated with turbulence in the superfluid. Following Feynman, it is suggested that this turbulence takes the form of a tangled mass of quantized vortex lines, so that the mutual friction probably arises from collisions between thermal excitations and these vortex lines. From the observed properties of the mutual friction it is deduced that the walls of the channel carrying the heat current play no essential role in the generation, maintenance or decay of the turbulence, but merely introduce a number of incidental complications; the present paper ignores these complications and deals therefore with the idealized case of a homogeneous heat current in an unbounded volume of helium. The turbulence in this idealized case must be homogeneous, and it is shown from experimental evidence that it is probably also isotropic. Values of the force exerted on unit length of a vortex line, which have been derived from the study of the attenuation of second sound in uniformly rotating helium, are used to calculate the Gorter–Mellink force per unit volume in terms of the length of line per unit volume; then by a simple dimensional argument it is shown that the force must depend on $(v_s - v_n)$ in a manner agreeing with experiment. An attempt is made to produce a detailed theory of the generation and decay of superfluid turbulence: it is shown that owing to the Magnus effect the turbulence can probably be built up by the action of the mutual friction force exerted on the individual lines, although the way in which turbulence can be initiated in undisturbed helium is not known, and secondly that the turbulence can probably decay in a manner closely analogous to the decay of homogeneous turbulence in an ordinary fluid. Equations for the rate of generation and decay of turbulence are obtained by dimensional arguments, and by analogy with formulae known to apply to turbulence in an ordinary fluid. Comparison of the equations with the experimental results described in Pt I and II reveals good agreement, and makes it possible to deduce the form and magnitude of a term describing the effect of the unknown initiation process. A.

536.48

155. THE TRANSITION TEMPERATURE IN LIQUID HELIUM. S.G.Brush.
Proc. Roy. Soc. A, Vol. 242, 544-57 (Nov. 19, 1957).

The partition function for an imperfect Bose–Einstein assembly of atoms is evaluated following Feynman's method, as modified by Kikuchi. The "effective mass" approximation is avoided, and instead a factor depending explicitly on interatomic forces is introduced. This factor is evaluated approximately for pairs of atoms interacting with a Lennard-Jones potential. The calculation involves only the properties of the individual helium atoms and disregards collective excitations. No adjustable parameters are used. A peak in the specific heat at 2.0° K is found (experimental, 2.2° K), and this transition temperature decreases with density. There is another transition at about 3.0° K which is probably a liquid–gas transition. If the interatomic forces are very weak one would only get this second transition; the λ transition does not occur at all unless the forces are of the order of magnitude of those actually found in helium. A.

536.48

156. SUSPENSION OF PARTICLES IN LIQUID HELIUM. K.L.Chopra and J.B.Brown.
Phys. Rev., Vol. 108, No. 1, 157 (Oct. 1, 1957).

In order to render the flow of liquid helium visible suspended solid particles were used. The particles consisted of an approximately equimolar mixture of hydrogen and deuterium. They were prepared by releasing a burst of the mixture into liquid helium of 1.4° K. Acoustic streaming is thus made accessible to visual observation. In helium I a turbulent movement is observed; in liquid helium II the motion is apparently streamline flow. The velocity is insensitive towards any variation of the temperature and is proportional to the square root of the intensity of sound. R.Eisenschitz

536.513 : 532.14

LIQUID OZONE THERMOMETERS. See Abstr. 62

536.521

157. SOME PROBLEMS IN LOW TEMPERATURE PYROMETRY. T.P.Gill.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1000-5 (Nov., 1957).

Some of the problems arising in low temperature pyrometry are considered, with special reference to the measurement of small temperature differences. In particular, the influence of changes in emissivity and the general spectral distribution of the energy exchange between two bodies at nearly the same temperature are discussed, and curves are given which are considered to be useful in the practical application of low temperature pyrometry. A.

536.521

158. OPTICAL PYROMETRY BELOW RED HEAT.
M.M.Benarie.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1005-9 (Nov., 1957).

Optical pyrometry is extended to the temperature range between 400°C and 500°C, by using a dark-adapted eye as the photometric comparison instrument. It is demonstrated experimentally and theoretically that in this range of temperature the accuracy of the scotopic optical pyrometry is not lower than that of pyrometry at higher temperatures where photopic vision is used. By means of a specially constructed extended-field blackbody, it is ascertained that the lowest temperature of the blackbody perceived by the scotopic eye as light emitting, is 391.5°C. This temperature, while reproducible within a few degrees by the same observer, seems to be subjected to a systematic shift with the age of the observer. In accordance with theoretical considerations, the advantage of a blue filter in optical pyrometry is advocated instead of the usual red filter. A.

536.631

159. HEAT CAPACITY OF TERBIUM FROM 15 TO 350°K.
L.D.Jennings, R.M.Stanton and F.H.Spedding.
J. chem. Phys., Vol. 27, No. 4, 909-13 (Oct., 1957).

This was measured and a lambda anomaly was observed with the peak at 227.7°K. There is, in addition, an anomalous region near 220°K. The heat capacity in this region depends on the thermal history of the sample. The value of the entropy at 273.16°K is 17.50 cal/(g atom.deg) in agreement with the value predicted on the assumption that at room temperature the 4f electrons have the same configuration as in the free tripositive ion. A.

536.631

160. ENTROPY, HEAT CAPACITY, AND HEATS OF TRANSITION OF 1,2,4-TRIMETHYLBENZENE.
W.E.Putnam and J.E.Kilpatrick.
J. chem. Phys., Vol. 27, No. 5, 1075-80 (Nov., 1957).

The heat capacity and the heats and temperatures of fusion of 1,2,4-trimethylbenzene were determined experimentally. This substance exhibits two melting points: at 229.33 ± 0.03°K and at about 224.2°K. The only solid phase having reproducible heat capacities was found to be the one having the highest melting point. The entropy of the ideal gas at 25°C and 1 atm pressure was found to be 99.59 ± 0.15 cal/deg.mole. A.

536.631 : 536.48

161. HEAT CAPACITY OF α BRASSES BELOW 4.2°K.
J.A.Rayne.
Phys. Rev., Vol. 108, No. 1, 22-5 (Oct. 1, 1957).

Heat capacity measurements below 4.2°K were made on a series of α-brasses with compositions ranging up to 34 wt% zinc. The variation of density of electronic states as a function of zinc composition suggests that the Fermi surface in copper deviates appreciably from sphericity. A comparison with theory and other experimental data concerning the shape of the Fermi surface in copper is given. A.

536.631 : 548.7

162. THE THERMAL PROPERTIES OF ALKALI HALIDE CRYSTALS. I. THE HEAT CAPACITY OF POTASSIUM CHLORIDE, POTASSIUM BROMIDE, POTASSIUM IODIDE AND SODIUM IODIDE BETWEEN 2.8 and 270°K. W.T.Berg and J.A.Morrison.
Proc. Roy. Soc. A, Vol. 242, 467-77 (Nov. 19, 1957).

The measurements were made with two adiabatic calorimeter assemblies, one for the temperature range 2.8 to 20°K and the other for the range 12 to 270°K. The working thermometer for the former assembly was a carbon resistor and for the latter a strain-free capsule-type platinum resistance thermometer. The crystals (pieces approximately 0.5 cm in dimension) were sealed in thin copper calorimeter vessels with a small amount of helium gas to promote heat exchange. The accuracy of the measurements is estimated to be ±2% at the lowest temperatures, rising rapidly to ±0.2% for T ≥ 20°K. The precision was generally better than this by about a factor of two at most temperatures. Apparent Debye characteristic temperatures (Θ_D) have been calculated for all of the experimental results. The variation of Θ_D with temperature is in general accord with the predictions of theory. Starting from the lowest temperatures, Θ_D for the three potassium salts first decreases to a minimum in the region of $T = \Theta_D/12$, then increases to a maximum in the region of $T = \Theta_D/2$ and subsequently decreases smoothly. Θ_D for sodium iodide shows the same behaviour at low temperatures but is still increasing at 270°K. A.

536.631 : 548.7

163. THE THERMAL PROPERTIES OF ALKALI HALIDE CRYSTALS. II. ANALYSIS OF EXPERIMENTAL RESULTS.
T.H.K.Barron, W.T.Berg and J.A.Morrison.
Proc. Roy. Soc. A, Vol. 242, 478-92 (Nov. 19, 1957).

The results reported in Pt I (see preceding abstract), together with similar results for sodium chloride, have been analysed in terms of the spectrum of harmonic vibrations of the crystalline lattice; since the zero-point energy proves to be small, the analysis should conform fairly closely to that of a static lattice. Θ_0 and the coefficients of the terms in ν^2, ν^4 and ν^6 in the low-frequency expansion of the spectrum have been derived from the data for the region $T < \Theta_D/20$. The values of Θ_0 agree well with Θ (elastic) calculated from the elastic properties of the crystals. After correction for thermal expansion, the results in the temperature range immediately above $\Theta_D/6$ yield Θ_∞ and the first three even moments of the spectrum (μ_2, μ_4 and μ_6) when fitted to the Thirring expansion for Θ_D. For the three potassium salts, and again for the two sodium salts, the ratio Θ_0/Θ_∞ appears to depend almost entirely upon the mass ratio of the ions. Values of this ratio suggest that the type of interatomic force is determined primarily by the alkali ion. Negative moments of the spectrum, together with μ_1 and the geometric mean frequency ν_g, have been derived from integrals of the form $\int_0^\infty C_v/T^s)dT$, with an accuracy comparable to that of the primary experimental heat capacities. Explicit spectra have not been computed, but instead ν_g, Θ_0 and the μ_n have all been correlated in a graph of the function $\nu_D(n) = \{\frac{1}{3}(n+3)\mu_n\}^{1/n}$. Potassium bromide is used as an illustrative example. The sharp curvature of the function $\nu_D(n)$ for negative values of n indicates that moments for $n < -1$ give critical information about the form of the spectrum. The zero-point energies of the crystals have been calculated from μ_1 and compared with values derived by the approximate method of Domb and Salter (1952). The estimated increase in the volume of the crystal caused by zero-point energy ranges from 0.23% for potassium iodide to 0.37% for sodium chloride. By subtracting the heat capacity given by the Thirring expansion one may estimate the effect of anharmonicity of the vibrations. This seems to be roughly determined by the ratio of the amplitude of atomic vibrations to the interatomic distance. A.

THERMODYNAMICS

536.7

164. THERMODYNAMICS OF IRREVERSIBLE PROCESSES.
K.Popoff.
C.R. Acad. Sci. (Paris), Vol. 245, No. 10, 925-6 (Sept. 2, 1957). In French.

The author sustains his point of view in a rather artificial argument with Péneloux. (See Abstr. 8433/1957). R.O.Davies

ELECTRICITY

ELECTROSTATICS. DIELECTRICS

537.226.2

165. DIELECTRIC PROPERTIES OF POLYETHYLENE GLYCOLS AT MICROWAVE FREQUENCIES. N.Koizumi.
J. chem. Phys., Vol. 27, No. 3, 625-30 (Sept., 1957).

The complex dielectric constants of ethylene, diethylene, triethylene, tetraethylene, and hexaethylene glycols in the liquid state were measured at frequencies of 1.43, 9.73, and 18.7 kMc/s at temperatures from 5 to 50°C. The parameters of dielectric relaxation for these polyethylene glycols have been calculated from the complex dielectric constants and the static dielectric constants by the circular arc rule of Cole and Cole. It is found that the dielectric relaxation times obtained do not vary much with the homologue of this polyethylene glycol series, being of the order of 10^{-10} sec at 20°C. The value of relaxation time is the largest for diethylene glycol, decreasing slightly with higher homologues of this series. This striking feature is discussed in terms of flexibility of the polyoxyethylene chain due to internal rotation around the C–O bonds of the chain skeleton, which would make more possible a partial and independent orientation of the hydroxyl groups at the ends of the molecular chain in the case of higher polyethylene glycols. A.

537.226.2

166. FERROELECTRICITY IN GLYCINE SILVER NITRATE. R.Pepinsky, Y.Okaya, D.P.Eastman and T.Mitsui.
Phys. Rev., Vol. 107, No. 6, 1538-9 (Sept. 15, 1957).

Glycine silver nitrate, $NH_2CH_2COOH \cdot AgNO_3$, is ferroelectric below −55° C. At −195° C the spontaneous polarization is 0.55×10^{-6} coulomb/cm^2, and the coercive field is 740 V/cm. The transition appears to be of second order. A differential thermal analysis does not reveal a specific heat anomaly. No dielectric anomalies appear between 4° K and −55° C. The spontaneous polarization, as in tri-glycine sulphate and isomorphs, is attributed to disturbance of the planarity of the glycine ion by the crystalline field. A.

537.226.2 : 537.311.32

167. DIELECTRIC CONSTANT AND CONDUCTIVITY OF GUANIDINE ALUMINIUM SULPHATE DURING SWITCHING. M.Prutton.
Proc. Phys. Soc. B, Vol. 70, Pt 7, 702-3 (July, 1957).

These were measured by means of a low-voltage–high-frequency signal while applying a large amplitude switching field at 50 c/s. The conductivity at the instant of peak switching current was related to the value of this current and to the coercive field by a simple law. The dielectric constant was found to increase with switching current and decrease with measuring frequency, but only obeyed the simple equation of a relaxation process in the absence of switching. K.W.Plessner

537.226.2

168. SURFACE AND SPACE-CHARGE EFFECTS IN CERAMIC BARIUM TITANATE. W.R.Büssem and E.C.Subbarao.
Naturwissenschaften, Vol. 44, No. 19, 509 (1957). In German.

An X-ray investigation of the surface layers of ceramic samples showed a departure from random orientation of the tetragonal crystallites. After grinding the surface, or after etching with HCl, this departure became very much more prounounced. A smaller effect was observed after ultraviolet irradiation. An explanation is given in terms of strong electric fields normal to the surface originating in surface charges. Such fields tend to align the c-axes normal to the surface. K.W.Plessner

ELECTRIC CONDUCTION. CURRENTS

537.311.1 : 539.2

169. A GENERAL EXPRESSION FOR THE CONDUCTIVITY TENSOR. R.Kubo.
Canad. J. Phys., Vol. 34, No. 12A, 1274-7 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). An exact formula for the electrical conductivity of a solid is derived and discussed. D.M.Edwards

537.311.1

170. A VARIATIONAL PRINCIPLE FOR CONDUCTION PHENOMENA IN THE PRESENCE OF A MAGNETIC FIELD OR ASYMMETRIC SCATTERING MECHANISMS. A.Seeger.
Canad. J. Phys., Vol. 34, No. 12A, 1278-80 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957).

537.311.31 : 539.21

171. ELECTRICAL RESISTANCE DUE TO LATTICE IMPERFECTIONS IN METALS. P.G.Klemens.
Canad. J. Phys., Vol. 34, No. 12A, 1212-18 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). Reports calculations on electron scattering in copper due to dislocations and stacking faults. A deformation potential method is used and equal interaction between electrons and waves of all polarizations is assumed. The interaction parameter is estimated from the low temperature thermal resistivity. It is concluded that at room temperature the dislocation resistivity is given by $\Delta\rho/\rho = 6.3 \times 10^{-15} N$, where N is the number of screw dislocations per unit area. The reflection coefficient of a stacking fault is estimated as 0.4. D.M.Edwards

537.311.31 : 539.21

172. ON THE ELECTRICAL RESISTIVITY OF STACKING-FAULTS IN MONOVALENT METALS. A.Seeger.
Canad. J. Phys., Vol. 34, No. 12A, 1219-35 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). The reflection coefficient R for electron scattering by a stacking-fault is calculated formally using perturbation theory. The potential used is that of two perfect half-crystals on each side of the stacking-fault displaced rigidly with respect to one another. The matrix elements occurring are related to other physical quantities and for copper R is estimated to lie in the range 0.1-0.5. This estimate is used to obtain good agreement with experiment for the ratio of the resistivity increase to the volume increase of cold-worked copper due to extended dislocations. A low stacking-fault energy can also account for the stored energy measurements which are 40 times smaller than would be expected if the resistivity increase were due to unextended dislocations (see Seeger and Stehle, Abstr. 1477/1957). Nickel and sodium are also discussed. D.M.Edwards

537.311.31

173. ELECTRICAL RESISTIVITY OF NICKEL–PALLADIUM ALLOYS. A.W.Overhauser and A.I.Schindler.
J. appl. Phys., Vol. 28, No. 5, 544-6 (May, 1957).

The concentration dependence of the residual resistivity of Ni–Pd alloys might be expected to obey a simple Nordheim law since the number of holes in the d band and the number of electrons in the s band are approximately independent of composition. Measurements have indicated, however, that the maximum resistivity occurs at 70 atomic % Pd instead of 50%. This behaviour can be explained by the spin dependence of electron scattering processes associated with the fact that the alloys with greater than 3% Ni are ferromagnetic. Quantitative fit of the data is possible if it is assumed that the density of states at the Fermi energy in the d band is approximately proportional to the number of holes, rather than to the cube root of this number. Data on the resistivity and paramagnetic susceptibility of Ag–Pd alloys support this hypothesis. The relative strength of s–d scattering to s–s scattering must be assumed to be about 5 : 1. A.

537.311.31

174. THE ELECTRICAL CONDUCTIVITY OF Ag_2F AND ITS TEMPERATURE DEPENDENCE.
R.Hilsch, G.v.Minnigerode and H.v.Wartenberg.
Naturwissenschaften, Vol. 44, No. 17, 463-4 (1957). In German.

After a description of the method of specimen preparation, results over the temperature range 300-1.4° K are given. Ag_2F exhibits metallic conduction, the room temperature resistivity being 2.4×10^{-5} ohm.cm. No superconductivity was observed.

K.W.Plessner

537.311.33

175. ON THE INJECTION OF CARRIERS INTO A DEPLETION LAYER. W.G.Matthei and F.A.Brand.
J. appl. Phys., Vol. 28, No. 4, 513-14 (April, 1957).

Reports two experiments with a point contact placed on the depletion layer of a p–n junction (22 Ω cm n-type, 0.7 Ω cm p-type) biassed 70 volts in reverse. The currents for various potentials of the point contact were observed and evidence obtained for simple single carrier injection up to certain voltages beyond which other effects seemed present. D.Haneman

537.311.33

176. FREQUENCY DEPENDENCE OF THE A.C. RESISTANCE OF THIN SEMICONDUCTING FILMS. M.Lax and R.Sachs.
Phys. Rev., Vol. 107, No. 3, 650-5 (Aug. 1, 1957).

The decrease with frequency of the a.c. "resistance" (reciprocal of the real part of the admittance) of thin semiconducting films is calculated on the assumption that this decrease is due to simple self-capacitance. The basic approach follows an earlier theory of Howe, but the local charge density along the film is determined by an integral transform of the voltage at all points of the film: $q(x) = \int C(x-x')V(x')dx'$ rather than by the local voltage $q(x) = CV(x)$, as in the Howe theory. The results agree with the experiments of Broudy and Levinstein (Abstr. 6618/1954). The agreement of the Howe theory with earlier experiments is shown to be partially fortuitous; it was evidently due to the use of physically inhomogeneous films in the earlier experiments. A.

537.311.33

177. NUCLEAR MAGNETIC RESONANCE IN SEMICONDUCTORS. II. QUADRUPOLE BROADENING OF NUCLEAR MAGNETIC RESONANCE LINES BY ELASTIC AXIAL DEFORMATION.
R.G.Shulman, B.J.Wyluda and P.W.Anderson.
Phys. Rev., Vol. 107, No. 4, 953-8 (Aug. 15, 1957).

For Pt I see Abstr. 1232 (1956). Nuclear electric-quadrupole moments interact with electric-field gradients at the nucleus. In a perfect cubic crystal, the average gradients vanish and there are no quadrupolar interactions. Nuclear magnetic resonance studies of the semiconductors InSb and GaSb revealed no quadrupolar interactions in the samples used, indicating a high degree of crystalline perfection. By applying stresses to these crystals, the crystalline symmetry could be reversibly destroyed, thereby producing quadrupole broadening of the nuclear magnetic resonance lines. Strains

of less than 10^{-4} were detected and the resulting field-gradients measured. The "gradient-elastic" proportionality constants connecting stress and field gradient are discussed in relation to crystal symmetry and are deduced from the measurements. A.

537.311.33 : 621.382.2

178. CARRIER GENERATION AND RECOMBINATION IN P–N JUNCTIONS AND P–N JUNCTION CHARACTERISTICS.
Chih-Tang Sah, R.N.Noyce and W.Shockley.
Proc. Inst. Radio Engrs, Vol. 45, No. 9, 1228-43 (Sept., 1957).

For certain p–n junctions, it has been observed that the measured current–voltage characteristics deviate from the ideal case of the diffusion model. It is shown that the current due to generation and recombination of carriers from generation–recombination centres in the space-charge region of a p–n junction accounts for the observed characteristics. This phenomenon dominates in semiconductors with large energy gap, low lifetimes, and low resistivity. This model not only accounts for the nonsaturable reverse current, but also predicts an apparent exp (qV/nkT) dependence of the forward current in a p–n junction. The relative importance of the diffusion current outside the space-charge layer and the recombination current inside the space-charge layer also explains the increase of the emitter efficiency of silicon transistors with emitter current. A correlation of the theory with experiment indicates that the energy level of the centres is a few kT from the intrinsic Fermi level. A.

537.311.33 : 538.63

179. LOW-TEMPERATURE GALVANOMAGNETIC EFFECTS IN BISMUTH MONOCRYSTALS. R.A.Connell and J.A.Marcus.
Phys. Rev., Vol. 107, No. 4, 940-6 (Aug. 15, 1957).

Measurements of the Hall coefficient and magnetoresistance were made on bismuth monocrystals at liquid helium temperatures in the range from 3 kilogauss to 16 kilogauss for all principal crystallographic orientations. Two complete sets of oriented crystals were used, one set was grown from unpurified bismuth, the other from zone-refined bismuth. Pronounced de Haas–van Alphen type oscillations were observed with the same periods for both galvanomagnetic effects. For a given orientation of the magnetic field with respect to the crystal axes, the periods were in good agreement with the values found in the de Haas–van Alphen effect and were independent of current direction. Impurities were found to have little effect on the period but a large effect on the amplitude of the oscillations and on the monotonic component of both magnetoresistance and Hall effect. A.

537.311.33 : 538.632 : 539.234

180. THE ELECTRICAL PROPERTIES AND REAL STRUCTURE OF SINGLE-CRYSTAL FILMS OF GERMANIUM OBTAINED BY VACUUM EVAPORATION.
G.A.Kurov, S.A.Semiletov and Z.G.Pinsker.
Kristallografiya, Vol. 2, No. 1, 59-63 (1957). In Russian.

Films were deposited on glass, corundum and single-crystal germanium. Data are given for electrical conductivity, carrier mobility and Hall effect. The single-crystal character of the films deposited on the germanium was established by electron-diffraction studies, supplemented by microscopic and electron microscopic examination. The carrier mobility is less in the single-crystal films than in massive single crystals. This is attributed to the presence in the films of defects which are, however, not detected by electron diffraction. (See also Abstr. 6755, 8304/1957).

R.F.S.Hearmon

537.311.33 : 621.315.59

181. THERMAL TURNOVER IN GERMANIUM P–N JUNCTIONS.
A.W.Matz.
Proc. Inst Elect. Engrs, Paper 2431R, publ. Nov., 1957 (Vol. 104B, 555-64).

The static reverse characteristics of an alloyed germanium p–n junction are analysed, taking into account an avalanche multiplication factor. The condition for thermal stability is examined, the onset of thermal runaway is related to a thermal turnover phenomenon, and the existence of a negative-resistance region is predicted. The existence of such thermal negative-resistance regions in germanium p–n junctions has been verified experimentally, and the results are analysed semi-quantitatively, showing fairly good agreement with the theory. A.

537.311.33 : 535.34

182. INFRARED RESONANT ABSORPTION FROM BOUND LANDAU LEVELS IN InSb. W.S.Boyle and A.D.Brailsford.
Phys. Rev., Vol. 107, No. 3, 903-4 (Aug. 1, 1957).

Transmission measurements as a function of magnetic field were carried out on n-type InSb at liquid helium temperature. The infrared resonant absorption was field-dependent and with a structure ascribed to Landau levels bound to donor impurities. The effective mass of the conduction band was estimated as 0.0155 m_0, a value higher than that obtained from microwave measurements.

B.T.M.Willis

537.311.33 : 535.34

183. OPTICAL ABSORPTION IN P-TYPE INDIUM ARSENIDE.
F.Stern and R.M.Talley.
Phys. Rev., Vol. 108, No. 1, 158-9 (Oct. 1, 1957).

An absorption peak was observed at 0.18 eV, and attributed to transitions between the light- and heavy-hole bands. In the analysis a spin–orbit splitting of 0.46 eV and a mean heavy-hole mass of 0.4 of the free-electron mass were used. A second smaller peak was noted at 0.055 eV, and attributed to lattice absorption.

B.T.M.Willis

537.311.33

184. ELECTRICAL PROPERTIES OF P-TYPE INDIUM ANTIMONIDE. T.Fukuroi and C.Yamanouchi.
Sci. Rep. Res. Insts Tôhoku Univ. A, Vol. 9, No. 4, 262-6 (Aug., 1957).

Electrical properties of p-type InSb from ambient to liquid-helium temperatures are measured and several parameters (conductivity, Hall coefficient and magnetoresistance) associated with the charge carriers are obtained. A.

537.311.33

185. MAGNESIUM VANADATE SPINELS WITH VALENCY-TYPE SEMICONDUCTOR PROPERTIES. B.Reuter and J.Siewert.
Naturwissenschaften, Vol. 44, No. 16, 440-1 (1957). In German.

In the solid-solution series MgV_2O_4–Mg_2VO_4, all having the spinel structure, a maximum conductivity is observed at the composition $V^{3+} : V^{4+} = 6.13 : 1$. The increased conductivity is attributed to exchange of valencies, while the displacement of the maximum from the expected composition $V^{3+} = V^{4+}$ is explained by the blocking effect of Mg ions in octahedral sites. K.W.Plessner

537.311.33

186. EFFECT OF OXYGEN ON THE CARRIER LIFE-TIME IN SILICON. D.H.Roberts, P.H.Stephens and P.H.Hunt.
Nature (London), Vol. 180, 665-6 (Sept. 28, 1957).

Oxygen content is gauged by the infrared absorption coefficient at 9 μ. Increased oxygen content increases the carrier lifetime. This is thought to be due to the oxygen acting on an unknown recombination centre so as to prevent it from functioning.

K.W.Plessner

537.311.33

187. OHMIC AND RECTIFYING CONTACTS TO SEMICONDUCTING CdS CRYSTALS. W.C.Walker and E.Y.Lambert.
J. appl. Phys., Vol. 28, No. 5, 635-6 (May, 1957).

The voltage–current characteristics for In and Ga point contacts on Cl-doped CdS crystals were linear whereas for Au, Cu, Pt, W, Zr, Al, and Pb point contacts they were rectifying.

C.A.Hogarth

537.311.33 : 535.89

188. MULTIPLE-BEAM APLANATIC RADIATORS AND DETECTORS. J.Oberly.
J. Opt. Soc. Amer., Vol. 47, No. 5, 439 (May, 1957).

The recombination radiation produced at rectifying contacts on germanium can be used in multidirectional infrared sources. Radiation originating at any point on the aplanatic surface within a germanium sphere emerges as a diverging conical beam of 30° angle. This surface, a smaller sphere, is exposed by grinding. Characteristics of a four-beam unit are given. Sources can also be made by embedding p-n junctions on the aplanatic surface of a moulded transparent hemisphere. Such units can be used in reverse as a multiple-beam detector, each junction responding to radiation within its own field of view. C.Hilsum

537.311.62

189. ON THE THEORY OF SKIN EFFECT IN METALS.
M.Ya.Azbel'.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1259 (1957). In Russian.

537.312.5

190. HYDROTHERMAL SYNTHESIS OF PHOTOCONDUCTIVE CADMIUM SULFIDE. A.Kremheller and A.K.Levine.
J. appl. Phys., Vol. 28, No. 6, 746-7 (June, 1957).

Unfired CdS together with chloride and $CuSO_4$ were heated to 350° C for 50 hours in an autoclave half-filled with de-ionized water. Photocurrent to dark current ratio $> 10^6$ at 3.5 ft. candles, the grain size was below 5 μ. J.Franks

537.312.5

191. INTERFERENCE PHOTOCATHODES OF ENHANCED YIELD WITH A CONTROLLABLE SPECTRAL RESPONSE. K.Deutscher.
Naturwissenschaften, Vol. 44, No. 18, 486-7 (1957). In German.

An antimony–caesium photoelectric cathode is deposited on a wedge-shaped MgF_2 film on an aluminium backing giving an interference reflection filter system. The photoelectric emission efficiency can thus be studied in relation to MgF_2 layer thickness by using a light probe. A sharp maximum in response at a given thickness and radiation wavelength indicates a method of improving response of photoelectric layers by reducing reflection and increasing absorption. G.F.J.Garlick

537.312.62

192. NUCLEAR RELAXATION IN SUPERCONDUCTING ALUMINUM. L.C.Hebel and C.P.Slichter.
Phys. Rev., Vol. 107, No. 3, 901-2 (Aug. 1, 1957).

Measurements were made on the signal from the normal metal, by re-applying a field $> H_c$ after allowing relaxation to occur in the superconducting state. At $0.94^\circ K$ ($T/T_c \sim 0.8$), the ratio R_s/R_n of relaxation rates in the superconducting and normal states was about 2. Using Hg, Reif has found $R_s/R_n \sim 0.1$ at $T/T_c = 0.27$. This change in R_s/R_n can be explained using an energy-gap model, but would be unexpected on a two-fluid model. The Bardeen–Cooper–Schrieffer model, with parameters chosen to give $R_s/R_n = 2$ at $T/T_c = 0.8$, gives $R_s/R_n = 0.13$ at $T/T_c = 0.27$. R.G.Chambers

537.312.62

193. MICROWAVE MEASUREMENTS OF THE ENERGY GAP IN SUPERCONDUCTING ALUMINUM.
M.A.Biondi, M.P.Garfunkel and A.O.McCoubrey.
Phys. Rev., Vol. 108, No. 2, 495-7 (Oct. 15, 1957).

Reports measurements on the variation of $r = R/R_n$ with $t = T/T_c$ (R = surface resistance, R_n = resistance in normal state, T_c = transition temperature), down to $t = 0.75$, at wavelengths between 19 mm ($h\nu = 0.65\ kT_c$) and 4.06 mm ($h\nu = 3.04\ kT_c$). At all frequencies, r starts to fall as soon as T falls below T_c, but for $h\nu > \sim kT_c$, the initial fall is gradual, whereas for $h\nu < \sim kT_c$, it is steep. Also, for $h\nu > \sim kT_c$, it is found that $r > r_c$, where the value of r_c is calculated theoretically by extrapolation from the low-frequency curves, using a two-fluid model. It is suggested that the additional absorption $r - r_c$ is due to quantum excitation of electrons across an energy gap $\Delta E(t)$, occurring when $h\nu > \Delta E(t)$. Hence, from the temperature at which $(r - r_c)$ vanishes at each frequency, the form of $\Delta E(t)$ is deduced, and found to agree quite closely with that predicted theoretically by Bardeen, Cooper and Schrieffer. R.G.Chambers

537.312.62

194. MILLIMETER WAVE STUDIES OF SUPERCONDUCTING TIN. M.A.Biondi, A.T.Forrester and M.P.Garfunkel.
Phys. Rev., Vol. 108, No. 2, 497-8 (Oct. 15, 1957).

Reports measurements down to $T/T_c = 0.45$, at wavelengths from 4.9 mm ($h\nu = 0.79\ kT_c$) to 1.75 mm ($h\nu = 2.2\ kT_c$). The method of measurement was to observe the fluctuating throughput of a tin waveguide as its temperature was periodically varied. The results obtained are similar to those found with aluminium (preceding abstract); using the same method of analysis, it is again found that the form of $\Delta E(t)$ agrees quite well with theory. The results differ considerably from those reported by Blevins et al. (Abstr. 1253/1956); in particular, R begins to fall as soon as T falls below T_c. R.G.Chambers

537.312.62

195. SUPERCONDUCTIVITY OF EVAPORATED LEAD FILMS WITH ADDED MANGANESE. N.Barth.
Z. Phys., Vol. 148, No. 5, 646-52 (1957). In German.

Addition of Mn depresses the transition temperature T_c; at about 0.3 atomic % Mn, T_c goes to zero. After annealing at $290^\circ K$, T_c regains its normal value. It is concluded that the solubility of Mn in Pb at $290^\circ K$ does not exceed 0.02 atomic %. R.G.Chambers

537.322.3

196. THE BENEDICKS EFFECT IN MERCURY. H.Wagenbreth.
Ann. Phys. (Leipzig), Vol. 19, No. 3-5, 166-8 (1956). In German.

Repetition of the measurements of Benedicks and Sederholm (1939-40) do not show the effect. It is concluded that its magnitude cannot exceed one hundredth part of the expected value. M.R.Hopkins

537.324

197. MEASUREMENT OF THE THERMOELECTRIC POWER OF A MOLTEN FeS–SOLID TUNGSTEN THERMOCOUPLE.
W.R.Bitler, Ling Yang and G.Derge.
J. appl. Phys., Vol. 28, No. 4, 514-15 (April, 1957).

This was measured by maintaining molten FeS in a U-tube with the two arms at different temperatures and by inserting a tungsten wire into the surface of the melt in each arm. The value is approximately $55\ \mu V/deg.\ C$ in a temperature range of $1200^\circ C$ to $1400^\circ C$. The results show the existence of electronic conduction in the molten material. M.R.Hopkins

ELECTRIC DISCHARGES

537.52 : 621.387.014

198. SOME MATHEMATICAL RELATIONS IN THE ELECTRIC ARC AND GLOW DISCHARGE AND THE DEFINITION OF THESE DISCHARGES. A.Bláha.
Elektrotech. Obzor, Vol. 45, No. 8, 391-4 (1956). In Czech.

A review of the description of arcs and discharges based on Compton's suggestion is given. It is shown that this classification is not satisfactory for long discharges as the ionizing mechanism is of a thermal nature in the arc and the electric mechanism occurs in the glow discharge. A discussion of other theories, mainly Steenbeck's and that of Schottky, is given to discuss a simplified, exact, and general theory of stabilized discharges. E.Erdélyi

537.521.6

199. MICROWAVE GAS DISCHARGE BREAKDOWN IN AIR, NITROGEN, AND OXYGEN. D.J.Rose and S.C.Brown.
J. appl. Phys., Vol. 28, No. 5, 561-3 (May, 1957).

The microwave breakdown electric field was measured for pure air uncontaminated by discharge products (presumably oxides of nitrogen), and for nitrogen and oxygen separately. The breakdown field for pure air is significantly higher than that previously observed, in which cases such contamination could be suspected. The breakdown field for pure air lies between those for nitrogen and oxygen. A calculation of the high-frequency breakdown field in air is made from d.c. data, using the measured Townsend ionization coefficient, electron attachment coefficient, and average electron energy. The present data agree well with this calculation. A.

537.521.7

200. ELECTRIC STRENGTH OF UNSATURATED HYDROCARBON GASES. A.E.D.Heylen.
Nature (London), Vol. 180, 703-4 (Oct. 5, 1957).

See Abstr. 2265/1957. Vs–pd measurements were extended to include n-pentane, n-hexane and their cyclo-derivatives together with n-octane, hexene–1 and isoprene. The effect of alkyl substitution around the carbon–carbon double bond has been further investigated by measurements in iso-butene, cis- and trans-butene-2, trimethylethylene and cyclo-pentene. Correlation between breakdown measurements and the ultraviolet spectra is reported. Contrary to other published work (Abstr. 2266/1957) the composite cross-section of the carbon–carbon single bond was found not to be zero, but of the same value as that of the carbon–hydrogen bond. Also the electric strength of cyclo-hexane exceeded that of cyclopentane over the entire pd range. A.E.D.Heylen

537.523.5

201. GLOW–ARC TRANSITION IN CURRENT-STABILIZED ELECTRICAL DISCHARGES. J.Jenkins and T.B.Jones.
J. appl. Phys., Vol. 28, No. 6, 663-8 (June, 1957).

The purpose was to measure the limits with regard to currents and time duration of the glow and arc modes for the low-current discharge at atmospheric pressure. In addition, some indications were obtained as to the conditions at the cathode which lead to such transitions. Accurate measurements in the normally unstable transition region were made possible through the use of a current stabilized power supply, together with special instrumentation for determining the magnitude and duration of the arc or glow voltage for periods as short as 0.02 microsecond. It is shown that glow–arc transitions can occur for currents as low as 0.002 amp and for currents at least as high as 1.0 amp in the atmospheric pressure argon discharge. The duration of the arc mode at low currents is usually less than 5 microseconds. These low current transitions occur only when an oxide film is present on the cathode and are caused by the action of high fields created by positive ions across the bulk of the thin oxide films. A.

537.523.5

202. MOTION OF AN ARC IN A MAGNETIC FIELD.
C.G.Smith.
J. appl. Phys., Vol. 28, No. 11, 1328-31 (Nov., 1957).

A magnetic field transverse to an arc tends to move the cathode spot in either the direction of the electromagnetic force (the Amperian sense) or in the opposite direction (the retrograde sense). The theory of A.E.Robson and A.von Engle assumes that an arc, bent over in the Amperian direction forms a loop in which the magnetic field of the arc opposes the applied field to yield the retrograde motion. Calculations here presented indicate that the arc field is too weak to uphold the theory. Retrograde motion proceeds continuously against a blast of vapour, while Amperian motion proceeds in the direction of the blast and is often discontinuous. These phenomena are recalled in giving an alternative explanation of the data. Examination of the "ball of fire" discharge, which can display retrograde motion, shows the excitation phenomena in the region between dark and bright plasma yields information about retrograde motion. Studies of the corresponding dark space and negative glow of an arc and a better knowledge of electron liberation at the cathode give promise of yielding information about the retrograde motion.
A.

537.523.5

203. THE EXCITATION THEORY OF ARCS WITH EVAPORATING CATHODES. A.von Engel and A.E.Robson.
Proc. Roy. Soc. A, Vol. 243, 217-36 (Dec. 24, 1957).

Most metals when used as the cathode of an arc discharge cannot reach temperatures sufficiently high to emit electrons thermionically. However, the temperatures are high enough to produce considerable evaporation. Mercury and copper are examples. The older theories suggest that here the current at the cathode is carried by electrons extracted by field emission, photoelectric emission or secondary emission by positive ions, or that the entire current is carried by positive ions produced by thermal ionization in the gas. All the theories are shown to be quantitatively inconsistent with observations. A new theory is suggested: electrons are released from the cathode by the impact of excited atoms. The electrons gain energy in the cathode fall and produce excited atoms in the dense vapour. The radiation from the excited atoms diffuses, mainly in the direction of the cathode, by successive absorption and re-emission in the vapour and is ultimately absorbed by atoms which strike the cathode. Positive ions are formed in the vapour by collisions between excited atoms, and by electrons colliding with excited atoms. The positive ions have three functions; their space charge provides the cathode fall in potential, they supply energy for evaporation and they transfer momentum to the evaporated atoms. The majority of the latter are back-scattered and in this way a vapour density is set up close to the cathode which is many orders of magnitude larger than elsewhere. An exceptionally high density, however, is a necessary condition for a low cathode fall and a high current density. The new picture is also consistent with the observed force on the cathode and the evaporation rate. The energy balance also supports the theory.
A.

537.525

204. MICROWAVE MEASUREMENTS OF THE PROPERTIES OF A D.C. HYDROGEN DISCHARGE.
B.J.Udelson, J.E.Creedon and J.C.French.
J. appl. Phys., Vol. 28, No. 6, 717-23 (June, 1957).

Microwave measurements of the properties of thin cross-sectional elements were made. These measurements were accomplished by exposure of portions of the discharge in the gap between the cones of an S-band re-entrant cavity operating in the TM_{010} mode. The equipment and techniques for making the microwave measurements employing the re-entrant cavity are described. Measurements in the positive column of a d.c. hydrogen discharge showed the following results: Electron density increases with increasing tube current and also with increasing gas pressure in the pressure range measured (2 to 8 mm Hg). Electron collision frequency is approximately equal to 4.6×10^9 multiplied by the gas pressure in mm Hg, and is independent of tube current. When measurements were made in the negative glow region, several anomalous effects including a negative frequency-shift were observed. These are explained qualitatively as being caused by plasma resonance phenomena. The fact that these plasma resonance phenomena were also observed at a frequency of 8550 Mc/s demonstrates that the electron density in portions of the negative glow is at least 300 times greater than the density in the positive column.
A.

537.525

205. THREE-DIMENSIONAL POTENTIAL WELL.
H.B.Williams.
Phys. Rev., Vol. 107, No. 5, 1451-2 (Sept. 1, 1957).

For positive charges, this can be created in high-frequency (50 Mc/s; r.f. voltage, 150 V peak) gas discharges at very low presures (0.2 micron Hg) due to multipacting of electrons into a thin disk of charge between two electrodes separated at 3 cm. For an electron current of 10 microampere corresponding to an r.f. input power of 20 V, the well has a value of 100 electron volts. This could be of use in nuclear-fusion processes.
A.E.D.Heylen

537.525.4

206. THE PULSATION OF A PLASMA THREAD.
A.G.Kulikovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 5, 984-7 (1957). In Russian.

This problem, which arises in connection with investigations of high-current-density spark discharges in a gas, was given an approximate solution by Leontovich and Osovets (Atomnaya Energiya, No. 3, 1956). In this paper a certain class of exact solutions of magnetohydrodynamic equations is put forward which contains periodic solutions. The solution obtained is readily generalized to allow for the lines of magnetic force being spiral.
C.R.S.Manders

537.527.5

207. A STUDY OF THE RADIAL EMISSION OF THERMAL RADIATION IN MODULATED MERCURY ARCS AT VERY HIGH PRESSURES. H.Zwicker.
Naturwissenschaften, Vol. 44, No. 16, 439-40 (1957). In German.

Briefly describes optical measurements on arcs modulated at frequencies varying between 50 and 2000 c/s. Radial variations of specific heat and phase shift between heat radiation and optical modulation are given graphically. There is a short discussion.
J.D.Craggs

537.529

208. ELECTRIC BREAKDOWN AND CONDUCTION THROUGH MYLAR FILMS. Y.Inuishi and D.A.Powers.
J. appl. Phys., Vol. 28, No. 9, 1017-22 (Sept., 1957).

D.C. breakdown studies on Mylar film show that defects cause a decrease in dielectric strength with decreasing film thickness at room temperature but not at -180°C. The breakdown at defects is associated with moisture content. Using self-healing electrodes to eliminate weak areas, a d.c. dielectric strength of 6 MV/cm is found, independent of film thickness. Prebreakdown current measurements indicate ionic currents which are fairly uniform throughout a sample, and field emission currents localized at incipient breakdown points. Breakdown probably occurs as a result of local heating by field emission currents.
A.

X-RAYS

537.531 : 535.33

209. LINES $L\beta_3$ AND $L\beta_4$ IN THE SPECTRUM OF GERMANIUM.
G.P.Borovikova and M.I.Korsunskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 6, 1192-4 (1957). In Russian.

Using Krasnikov's fluorescence-analysis tube (Zavodskaya Laboratoriya, 1939) and a high-vacuum spectrograph, the authors have detected two lines at 9561 and 9620 X, of which the more intense former line has been attributed to $L\beta_3$, and the latter to $L\beta_4$.
F.Lachman

537.531 : 523.75

X-RAY EMISSION IN A SOLAR FLARE. See Abstr. 15

CATHODE RAYS. POSITIVE RAYS

537.533.8

210. ESTIMATE OF THE TIME CONSTANT OF SECONDARY EMISSION. A.van der Ziel.
J. appl. Phys., Vol. 28, No. 10, 1216-17 (Oct., 1957).

The time constant for electron emission from metals and semiconductors is determined from energy considerations. Lattice electrons are considered in two groups: normal lattice electrons, and

excited electrons, the latter having educed energy from collisions with primary electrons. The time constant is calculated as the time necessary to build up a steady state of excited electrons at the surface. C.G.Morgan

537.534.8

211. SECONDARY ELECTRON EMISSION DUE TO SODIUM ION BOMBARDMENT OF STRESSED METAL FILAMENTS.
R.Goutte and C.Guillaud.
J. Phys. Radium, Vol. 18, No. 3, 202-3 (March, 1957). In French.

Yields of 0.3 to 0.35 were obtained for nickel, silver and gold, increasing by 6, 5.5 and 3% respectively when the stress was increased to breaking point. Such increases were comparable with those previously found for photoemission. The filaments were contaminated by the sodium ions. D.Haneman

537.534.8

212. THEORY OF SECONDARY ELECTRON EMISSION BY HIGH-SPEED IONS. E.J.Sternglass.
Phys. Rev., Vol. 108, No. 1, 1-12 (Oct. 1, 1957).

The physical mechanism of secondary electron emission under the impact of high-speed heavy particles is analysed. The treatment is based on the formation of secondaries according to the Bohr–Bethe theory of ionization, the diffusion of the slow secondaries to the surface, and their subsequent escape in the vacuum. The yield is found to be proportional to the rate of energy loss of the incident particles, and it is shown to be essentially the same for all metals, independent of their work-function, conductivity, and other bulk properties. The observed energy distribution of the secondaries, the effect of adsorbed layers and the dependence of the yield on temperature, particle charge, and velocity are found to be explained in terms of this mechanism. The application to the general problem of the escape of electrons from metals and to the study of electron capture and loss by ions passing through solids is discussed. A.

537.534.9 : 548.574

213. ETCHING OF DIELECTRICS BY IONIC BOMBARDMENT.
G.V.Spivak, A.I.Krokhina, T.V.Yavorskaya and Yu.A.Durasova.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 5, 1001-3 (1957). In Russian.

Details are given of the technique and conditions required to produce etch figures on dielectrics by bombardment with neon ions. Examples are reproduced of the figures obtained with quartz, common salt and Rochelle salt. R.F.S.Hearmon

DISCHARGE TUBES IONIZATION. THERMIONICS

537.561

214. IONIZATION AND DISSOCIATION OF PERCHLORYL-FLUORIDE BY ELECTRON IMPACT.
V.H.Dibeler, R.M.Reese and D.E.Mann.
J. chem. Phys., Vol. 27, No. 1, 176-9 (July, 1957).

Relative abundances and appearance potentials are reported for both positive and negative ions observed in the mass spectrum of perchlorylfluoride. Appearance potentials of the atom ions result in a value for $\Delta H_f(ClO_3F)$ of nearly zero within the experimental uncertainty. Bond dissociation energies and ionization potentials of the chloryl radicals are estimated from appearance potentials of the polyatomic ions. The energetics of probable ionization–dissociation processes are compared with observed data. A.

537.563

215. ORGANIC IONS IN THE GAS PHASE. IV. $C_7H_7^+$ AND $C_5H_5^+$ IONS FROM ALKYLBENZENES AND CYCLOHEPTATRIENE.
S.Meyerson and P.N.Rylander.
J. chem. Phys., Vol. 27, No. 4. 901-4 (Oct., 1957).

Electron-impact studies have led to the proposal that the $C_7H_7^+$ ion derived from toluene is not benzyl but tropylium. The mass spectra of toluene-α-C^{13} and cycloheptatriene confirm this proposal. Energy considerations indicate that toluene and related aromatic hydrocarbons yield the same kind of $C_7H_7^+$ ion as cycloheptatriene, and that formation of this ion from toluene and cycloheptatriene proceeds through the same intermediate. A metastable peak, labelling, and correlations indicate that $C_5H_5^+$ ions from n-alkylbenzenes are derived in part from a $C_7H_8^+$ precursor, and not exclusively from $C_7H_7^+$. A.

537.563

216. ORGANIC IONS IN THE GAS PHASE. V. $C_6H_5^+$ ION FROM TOLUENE. P.N.Rylander and S.Meyerson.
J. chem. Phys., Vol. 27. No. 5, 1116-17 (Nov., 1957).

The $C_6H_5^+$ ion obtained from toluene by electron impact is not formed simply by cleavage of the phenylmethyl bond, as has been assumed, and may not be a phenyl ion at all. The apparent identity of this ion with the $C_6H_5^+$ ion derived from benzene leads to the inference that the latter, also, may not be a phenyl ion. A.

COSMIC RAYS

537.591.15

217. ON HEAVY PRIMARY CASCADES.
R.R.Hillier and C.J.Waddington.
Nuovo Cimento, Vol. 6, No. 2, 403 (Aug., 1957).

Points out that the anomalously short mean-free-paths reported recently are probably due to the limited thickness of the detecting emulsions. K.H.Barker

537.591.15

218. OBSERVATIONS ON EXTENSIVE AIR SHOWERS.
I. APPARATUS. T.E.Cranshaw and W.Galbraith.
Phil. Mag. (Eighth Ser.), Vol. 2, 797-803 (June, 1957).

Deals with an air-shower experiment using G.M. counters in a triangular array covering 0.5 km^2. Details are given of the recording apparatus which incorporates a Hollerith machine and, in appendices, of a counter-quenching circuit and a pulse-adding circuit. K.H.Barker

537.591.15

219. OBSERVATIONS ON EXTENSIVE AIR SHOWERS.
II. TIME VARIATIONS IN THE ENERGY REGION OF 10^{17} eV.
T.E.Cranshaw and W.Galbraith.
Phil. Mag. (Eighth Ser.), Vol. 2, 804-10 (June, 1957).

The rates of arrival of extensive air showers near sea level have been recorded over a period of almost two years. The results show no evidence for sidereal variations in the rates, and the bearing of this in theories of the origin of cosmic radiation is discussed. Evidence is presented of statistically significant variations in solar time for showers containing a mean number of particles of 3×10^7, and the significance of this is briefly discussed. A.

537.591.15

220. OBSERVATIONS ON EXTENSIVE AIR SHOWERS.
III. THE DISTRIBUTION OF CHARGED PARTICLES.
T.E.Cranshaw, W.Galbraith and N.A.Porter.
Phil. Mag. (Eighth Ser.), Vol. 2, 891-9 (July, 1957).

The distribution of charged particles in air showers containing 3×10^6, 3×10^7 and 10^8 particles at sea level has been measured and compared with theoretical calculations by Nishimura and Kamata. The best value of the age parameter S appears to be 1.4. The significance of this result is briefly discussed. A.

537.591.15

221. OBSERVATIONS ON EXTENSIVE AIR SHOWERS.
IV. THE LATERAL DISTRIBUTION OF PENETRATING PARTICLES.
N.A.Porter, T.E.Cranshaw and W.Galbraith.
Phil. Mag. (Eighth Ser.), Vol. 2, 900-9 (July, 1957).

The lateral distribution of the penetrating component has been measured in showers containing more than 3×10^6 charged particles. Between 300 and 500 metres, the distribution follows a power law with exponent 1.5, and falls more steeply beyond 500 metres. The median spread of the particles is about 500 metres. The interacting component falls off more steeply, and was not detectable beyond 150 metres. About 8.5% of all the particles are penetrating, and of these, about 10% are interacting. The results are compared with theoretical models, and good agreement is obtained with the predictions of Rozental, based on a Fermi model of the nuclear interaction. The results appear to be in conflict with the hypothesis that the primaries of air showers might be high energy dust grains. A.

537.591.5

222. STUDY OF GEOMAGNETIC CUTOFF ENERGIES AND TEMPORAL VARIATION OF THE PRIMARY COSMIC RADIATION
F.B.McDonald.
Phys. Rev., Vol. 107, No. 5, 1386-95 (Sept. 1, 1957).

The results of a series of six Skyhook balloon flights with combination Cherenkov–scintillation detectors, are used to study

spectral cutoffs as a function of latitude and to observe some aspects of temporal variations at high altitude of the alpha-particles of the primary cosmic-radiation. Observed cutoff energies are found to be in strong disagreement with geomagnetic theory. In one large cosmic-ray decrease the very low-energy portion of the cosmic-ray energy spectrum (300-600 MeV/nucleon) does not seem to be strongly affected. A.

537.591.8

223. INTERACTIONS OF μ-MESONS UNDERGROUND (180 m.w.e.) S.Naranan, P.V.Ramanamurty, A.B.Sahiar and B.V.Sreekantan. Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1773-6 (June, 1957).

From an examination of 6884 cloud-chamber photographs it is concluded that, in accord with other investigations, there is no evidence for associated pairs of penetrating particles (A.P.P.), and that the upper limit for nuclear interaction of μ-mesons of mean energy 47 GeV is $(5.7 \pm 2.8) \times 10^{-30}$ cm^2/nucleon. K.H.Barker

MAGNETISM

538.114

224. ON THE WIDTH AND ENERGY OF DOMAIN WALLS IN SMALL MULTI-DOMAIN PARTICLES. H.Amar. J. appl. Phys., Vol. 28, No. 6, 732-3 (June, 1957).

A two-domain ferromagnetic particle is considered. It is shown that the inclusion of the magnetostatic energy in the derivation of the wall characteristics yields values of these characteristics considerably different from those in bulk material. A.

538.114

225. "SATELLITE-ELECTRON" THEORY OF FERROMAGNETISM, ANTIFERROMAGNETISM AND RELATED PHENOMENA. L.Singh. Naturwissenschaften, Vol. 44, No. 15, 417-18 (1957).

An account of a speculative theory of ferromagnetism based on satellite orbits of the unpaired 3d-electrons. Magnetic properties of transition-metal oxides are discussed in the light of the concept of these satellite orbits. A.E.De Barr

538.114 : 548.7

226. HIGH TEMPERATURE SUSCEPTIBILITY EXPANSIONS FOR THE CLOSE PACKED HEXAGONAL LATTICE. C.Domb and M.F.Sykes. Proc. Phys. Soc. B, Vol. 70, Pt 9, 896-7 (Sept., 1957).

Expressions are derived for coefficients of T^{-5} and T^{-6} (Abstr. 2224/1956). The coefficient of T^{-6} differs slightly from that for the face-centred cubic lattice. A.R.Stokes

538.122.08 : 621.317.42

227. ON THE DESIGN OF MAGNETIC MODULATION DETECTORS FOR MAGNETIC FIELD INTENSITY [MEASUREMENT]. M.A.Rozenblat. Elektrichestvo, 1957, No. 7, 24-31. In Russian.

The type of detector studied consists of an inductor with a high-permeability open core which is placed in the field to be measured. A sinusoidal m.m.f., large enough to saturate the core, is superposed on the unknown field and from the wave-shape of the resultant e.m.f. the unknown intensity can be derived. Formulae are derived for various design-considerations, including sensitivity, physical dimensions and core properties. Tables and graphs indicate good agreement between calculated and measured data. J.B.Arthur

538.22 : 548.736.4

228. LITHIUM–NICKEL FLUORIDE, Li_2NiF_4, A FLUORSPINEL. W.Rüdorff and J.Kandler. Naturwissenschaften, Vol. 44, No. 15, 418 (1957). In German.

Describes the preparation and some of the properties of a new compound Li_2NiF_4. This is an inverted spinel with a face-centred cubic structure of lattice parameter 8.313 A. The Curie law is obeyed from 77° to 473° K, and the magnetic moment is found to be 3.18 Bohr magnetons. A.E.De Barr

538.221 : 548.7

229. EVIDENCE FOR SUBGRAINS IN MnBi CRYSTALS FROM BITTER PATTERNS. W.C.Ellis, H.J.Williams and R.C.Sherwood. J. appl. Phys., Vol. 28, No. 10, 1215-16 (Oct., 1957).

Bitter patterns on a surface containing the c axis in a single crystal of MnBi show that each magnetic domain consists of subdomains because of slight differences of orientation of the c axis in each subgrain. Laue reflections confirm that the spread of orientation of a given plane is about 2°. A.E.De Barr

538.221

230. FERRIMAGNETIC RESONANCE IN GADOLINIUM IRON GARNET. B.A.Calhoun, J.Overmeyer and W.V.Smith. Phys. Rev., Vol. 107, No. 4, 993-4 (Aug. 15, 1957).

Ferrimagnetic resonance was observed from −192° C to 72° C. The apparent g-factor and line-width have their maximum values at the compensation point (13° C). The coincidence of the maximum g with the vanishing of the magnetization implies that the g-factors of the Gd^{+3} and Fe^{+3} are equal. The temperature dependence of the integrated intensity of the absorption is very similar to that of the magnetization. Below −150° C, both g and the line-width increase with decreasing temperature. A.

538.222

231. MAGNETIC SUSCEPTIBILITIES OF SOME Pu^{+4} COMPOUNDS. W.B.Lewis and N.Elliott. J. chem. Phys., Vol. 27, No. 4, 904-8 (Oct., 1957).

The magnetic susceptibilities of $Pu(SO_4)_2.4H_2O$, $Rb_4Pu(SO_4)_4.2H_2O$, $Pu(C_2O_4)_2.6H_2O$, $[(CH_3)_4N]_2$-$PuCl_6$, and PuF_4 were measured over the temperature range 77-334° K. The large departures from the Curie–Weiss law observed in these salts are discussed in terms of the crystalline field symmetry. A.

538.222

232. COMPLEX MAGNETIC PERMEABILITY TENSOR AND PARAMAGNETIC RESONANCE ABSORPTION IN $CuSO_4.5H_2O$. K.Sundaramma. Proc. Indian Acad. Sci. A, Vol. 46, No. 3, 232-7 (Sept., 1957).

Absolute values of the imaginary part of the magnetic susceptibility are obtained from electron resonance intensities in a single crystal of $CuSO_4.5H_2O$. Despite large variations of line widths and peak intensities, the integrated absorption tensor is nearly spherical with axes 6.81 cm^{3}gauss along L_1, the normal to the plane containing the tetragonal axes of the crystallographically distinct Cu^{++} ions, and 7.38 cm^{3}gauss in that plane. These values are in agreement with the static susceptibilities to which they are related by the Kramers–Kronig relationship. D.H.Whiffen

538.24 : 537.312.8

233. MAGNETIZATION AND MAGNETORESISTANCE OF SOME DILUTE ALLOYS OF Mn IN Cu. R.W.Schmitt and I.S.Jacobs. Canad. J. Phys., Vol. 34, No. 12A, 1285-9 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). Gives results of magnetoresistance and magnetization measurements at low temperatures on alloys of 0.2-1.8% (atomic) of Mn in Cu. The results indicate the onset of a cooperative magnetic effect in these alloys, and are discussed in relation to possible domain structures. A.E.De Barr

538.245

234. FREQUENCY SPECTRUM OF THE BARKHAUSEN NOISE. G.Biorci and D.Pescetti. J. appl. Phys., Vol. 28, No. 7, 777-80 (July, 1957).

The spectral density of the Barkhausen noise was measured and a theoretical interpretation of the results is given. It is assumed that the single pulse is exponential with a time constant of the order of 10^{-4} sec. Then the computed spectral density is constant up to 1 kc/s, and then decreases exponentially. This behaviour is only slightly dependent on the shape of the pulse. The theoretical conclusions are in good agreement with experimental data taken on iron, nickel, and ferroxcube specimens. The usual model introduced to explain the mechanism giving rise to the noise leads to the conclusion that the intensity of the spectrum is proportional to the frequency of the magnetizing current. This conclusion is not experimentally verified because of the extreme simplifications involved in the model itself. A.

538.245

235. A MAGNETIC HEATING EFFECT IN OXIDIZED NICKEL WIRES. C.Schwink. Naturwissenschaften, Vol. 44, No. 18, 485-6 (1957). In German.

Electron-optical shadow experiments are reported on stressed oxidized nickel wires which enable the distance p between the effective pole position (that where the leakage field is perpendicular to the wire) and the end of the wire to be determined. The oxide layer is found to alter p due to its straining action on the underlying metal. The effect of an alternating field was also investigated. E.P.Wohlfarth

538.245

236. MAGNETIZATION OF ILMENITE–HEMATITE SYSTEM AT LOW TEMPERATURES.
R.M.Bozorth, D.E.Walsh and A.J.Williams.
Phys. Rev., Vol. 108, No. 1, 157-8 (Oct. 1, 1957).

Reports results of magnetization measurements between 1.3^0K and room temperature and in fields up to 11 000 oersted on the substances $Fe_{1+x}Ti_{1-x}O_3$ $(0 < x < 1)$. The effective Bohr magneton numbers are deduced, and only agree with a simple linear variation near 20% Fe_2O_3 where p_B has its maximum value 3. E.P.Wohlfarth

538.245

237. A CORRELATION OF THE THERMOMAGNETIC AND DOMAIN BEHAVIOUR OF A SINGLE CRYSTAL OF SILICON–IRON.
L.F.Bates, D.A.Christoffel, H.Clow and P.F.Davis.
Proc. Roy. Soc. A, Vol. 243, 160-71 (Dec. 24, 1957).

The thermal changes accompanying the magnetization of a single-crystal specimen of silicon–iron along a [001] direction have been measured and a Bitter figure study made of the same specimen. Some success has been obtained in the correlation of the thermal changes in low fields with the appearance of Néel spikes and domains of reverse magnetization. A.

538.27 : 537.311.31

238. DE HAAS–VAN ALPHEN OSCILLATIONS IN THE THERMAL AND ELECTRICAL MAGNETORESISTANCE OF TIN.
P.B.Alers.
Phys. Rev., Vol. 107, No. 4, 959-60 (Aug. 15, 1957).

Oscillatory behaviour of the de Haas–van Alphen type was found in both the electrical and thermal magnetoresistance of a tin single crystal at liquid helium temperatures. Measurements were made in magnetic fields ranging from 22 to 25 kilogauss. The tetragonal axis of the crystal was parallel to the field and perpendicular to the rod axis. The thermal and electrical oscillations were in phase and yielded values for β^*/E_0 of 5.7×10^{-7} gauss^{-1}, respectively. This is in substantial agreement with the value (5.9×10^{-7} gauss^{-1}) deduced by Shoenberg from diamagnetic susceptibility measurements. A.

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3 : 530.12

239. CHARGED MATTER AND PURE ELECTROMAGNETIC FIELD DISTRIBUTION. L.Mariot.
C.R. Acad. Sci. (Paris), Vol. 245, No. 6, 630-1 (Aug. 5, 1957). In French.

It is shown that the singular field (Abstr. 9395/1954) cannot exist in Riemannian space-time in the presence of matter. R.A.Newing

538.3 : 530.12

240. THE COMPLETELY INTEGRABLE SINGULAR ELECTROMAGNETIC FIELD. L.Mariot.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1386-8 (Oct. 21, 1957). In French.

538.3 : 530.12

241. ELECTROMAGNETIC INDUCTION IN A RELATIVISTIC ANISOTROPIC MEDIUM. Pham Mau Quan.
C.R. Acad. Sci. (Paris), Vol. 245, No. 21, 1782-5 (Nov. 18, 1957). In French.

Maxwell's equations in an anisotropic medium are discussed by setting up at each point of space-time three matrices in the tangent vector space which represent the dielectric constant, the magnetic permeability and the electrical conductivity of the medium. G.Stephenson

538.3 : 532.5

242. NEWTONIAN DEVELOPMENT OF THE DYNAMICAL PROPERTIES OF IONIZED GASES OF LOW DENSITY. E.N.Parker.
Phys. Rev., Vol. 107, No. 4, 924-33 (Aug. 15, 1957).

The macroscopic dynamical equations of a tenuous ionized gas in a magnetic field are developed by averaging over the individual ion and electron motions, which do not necessarily possess an isotropic distribution. It is shown that the principal motion of the gas is related to the magnetic field by the usual hydromagnetic equations, as developed for conducting liquids and dense gases; the anisotropy of the individual particle motions shows up primarily as a coefficient multiplying the pondermotive force exerted by the magnetic field on the plasma. The results reduce properly to the earlier work of Schüter, Cowling, and Spitzer for isotropic pressure, and are in agreement with the recent developments from the Boltzmann equation. It is pointed out that the magnetic lines of force are permanently connected and move in the frame of reference of the electric drift. It is shown that near static equilibrium, when the principal motions vanish, there remain small macroscopic drift motions of the gas in the field inhomogeneities. It is also shown that the field equations, obtained by assuming that the radius of gyration of the thermal motions is small compared to the scale of the field, are valid even near neutral surfaces, on which the field density vanishes. A.

538.3 : 532.5

THE OSCILLATIONS OF AN INFINITE CYLINDER OF GAS IN A MAGNETIC FIELD. See Abstr. 63

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.566.2 : 621.372

243. ON THE REFLECTION OF AN ELECTROMAGNETIC PLANE WAVE BY A PERFECTLY CONDUCTING ROUGH SURFACE. J.P.Schouten and A.T.de Hoop.
Ann. Télécomm., Vol. 12, No. 5, 211-14 (May, 1957). In French.

The surface has periodicities of λ_1 and λ_2 in x and y. The present theory is an extension of that of Rice (Abstr. 2851/1952; Commun. Pure Appl. Math., Vol. 4, 351-78, Aug., 1951) because it considers $\lambda_1 \neq \lambda_2$ and the only limitation on the plane of incidence is that it should contain the z-axis. It is shown that the reflected field is the sum of a finite series of progressive and evanescent waves. W.T.Blackband

538.566.3

244. PROPAGATION OF A PLANE ELECTROMAGNETIC WAVE ACROSS AN IONOSPHERIC LAYER. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 244, No. 25, 3045-7 (June 17, 1957). In French.

Simplified expressions are given for the electric and magnetic fields of an e.m. wave involving two arbitrary constants which can be found from a pair of linear equations. G.M.Brown

538.566.3

245. ON THE INTERACTION OF RADIO WAVES.
V.A.Bailey.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1430-49 (1956).

Historical account of the theory of radio wave-interaction in the E layer. The classical work of Townsend on the motions of slow electrons in gases is summarized and it is shown that the effect of an alternating electric field is to increase the collisional frequency of the electrons. This accounts for the so-called "Luxembourg effect", and when allowance is made for the presence of a magnetic field also leads to the concept of gyro-interaction when the interfering carrier frequency is equal to the local gyro-frequency. The theory also predicts the self-distortion of a powerful wave, and this may be related to the phenomenon of self-demodulation discovered by Cutolo (Abstr. 2616/1954). It is shown that the empirical formulae of Crompton, Huxley and Sutton (Abstr. 6901/1953) for the motion of slow electrons in air lead to certain inconsistencies when the mean energy of the electrons approaches that of the surrounding gas molecules. G.M.Brown

538.566.3 : 621.376 : 621.396.8

246. IONOSPHERIC DEMODULATION OF RADIO WAVES AT VERTICAL INCIDENCE. G.J.Aitchison.
Austral. J. Phys., Vol. 10, No. 1, 204-7 (March, 1957).

A mechanism is presented whereby the demodulation of vertically reflected waves of frequency close to the local gyro-frequency can be explained in terms of interaction between the two magneto-ionic components in the E-layer. The theory is not able to account quantitatively for the observed degree of demodulation, but does indicate that it occurs in the E-layer and that the ordinary wave is affected on both its upward and downward paths to and from a higher layer. G.M.Brown

538.566.3 : 621.376 : 621.396.812

247. SOME REMARKS ON THE THEORY OF SELF-DEMODULATION. M.Carlevaro.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1422-9 (1956).

Mathematical treatment of the self-demodulation of a radio-wave on the basis of the theory of interaction. In the simple theory, considerable difficulties are encountered. In particular, the reverse of the theoretical prediction that the demodulation should decrease as the modulation frequency increases is observed experimentally. G.M.Brown

538.566.3 : 621.376 : 621.396.812

248. IONOSPHERIC SELF-DEMODULATION OF RADIOWAVES. M.Cutolo, G.C.Bonghi, F.Immirzi and P.Cachon.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1450-9 (1956).

Experiments on the demodulation of modulated carrier waves after reflection in the ionosphere show that the change of modulation depth is, in general, too small to be measured for carrier frequencies which are very far from the local gyro-frequency, but is detectable for frequencies reasonably far from gyro-frequency when the power transmitted is very high. For frequencies near and equal to the gyro-frequency the percentage demodulation becomes large. Consideration is given to the dependence on the modulation-frequency, and reasons are advanced why the phenomenon cannot be considered to be due to selective fading. G.M.Brown

538.566.3 : 523.75

EFFECT OF A SOLAR FLARE ON E.M. WAVE PROPAGATION.
See Abstr. 16

538.567

249. ANOMALOUS DISPERSION OF LOW-FREQUENCY ELECTRIC WAVES. K.Rehfeld.
Naturwissenschaften, Vol. 44, No. 15, 416-17 (1957). In German.

A study of the anomalous dispersion of waves with frequencies of order 10^4 c/s by mixtures, such as propanol and carbon tetrachloride. The theoretical significance of the results is discussed. P.M.Davidson

NUCLEAR AND ATOMIC PHYSICS

539.1

250. INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 2, 179-866 (1956).

This conference was held at Pisa in June, 1955 under the auspices of The International Union of Physics and of Consiglio Nazionale delle Ricerche. Papers are divided into two groups: Heavy unstable particles; and Quantum field theory and interactions between mesons and nucleons. Abstracts will be published under their appropriate headings.

APPARATUS. PARTICLE DETECTORS

539.1.07

251. GAMMA-RAY MONITOR HAS HIGH RELIABILITY. J.M.Jackson and J.J.Suran.
Electronics, Vol. 30, No. 11, 170-4 (Nov. 1, 1957).

Details of construction and operation of a gamma-ray monitor with an adjustable alarm device are given. Transistors are used in all circuits with the exception of a conventional Geiger-Muller tube. Detection of gamma-radiation of a rate ranging from 1 to 10^3 mr/hr with 40% accuracy is claimed. J.M.Zarzycki

539.1.07 : 539.165.08

252. LOW-BACKGROUND COUNTER FOR SOLID β-EMITTING SAMPLES. S.D.Softky and R.E.Nather.
Nucleonics, Vol. 15, No. 5, 90-3 (May, 1957).

Description of a flow counter moulded from Epon 828 resin that can be used either as a G M. or proportional counter. An anticoincidence "umbrella" of 11 G.M. tubes and 8 in. thick mild steel shields is used to reduce background. R.D.Smith

539.1.07 : 539.185.08

253. BF_3 NEUTRON SPARK COUNTER.
M.J.Swetnick and N.G.Anton.
Nucleonics, Vol. 15, No. 6, 93 (June, 1957).

A Rosenblum spark counter filled with $B^{10}F_3$ gas (96% B^{10}) at 45 cm Hg pressure gave a slow-neutron detection efficiency of 0.6% and was insensitive to γ-radiation of 500 r/hr. R.D.Smith

539.1.07 : 539.185.08

254. OPERATING CHARACTERISTICS OF THE SPARK COUNTER. N.K.Saha and N.Nath.
Nucleonics, Vol. 15, No. 6, 94-7 (June, 1957).

The operation of a Rosenblum counter is interpreted in terms of the space-charge sheath surrounding the fine-wire anode, the effective voltage across the counter and the size of the avalanche produced by an ionizing particle. The dependence of the counting rate on the counter voltage and temperature and on the collimation of the incident particles was determined. A thin layer of boron in front of the counter converts it to an efficient neutron detector insensitive to γ-radiation. R.D.Smith

539.1.07 : 537.312.5 : 621.383.27

255. TEMPERATURE DEPENDENCE OF PHOTOMULTIPLIER GAIN. F.E.Kinard.
Nucleonics, Vol. 15, No. 4, 92, 94-97 (April, 1957).

Using a NaI:Tl crystal and a photomultiplier, the pulse height of the photopeak from a Cs^{137} source was observed as a function of the temperature of the dynode assembly, the photocathode, and the crystal over the range -15°C to $+50^\circ$C. The gain was independent of the photocathode temperature but decreased by amounts up to 40% with increasing dynode temperature. The temperature of the crystal affects the decay time of the light pulse but with proper amplifier design the temperature dependence of pulse height may be minimized. R.D.Smith

539.1.07

256. PROPERTIES OF MASS-PRODUCED SCINTILLATION MULTIPLIERS.
P.Görlich, A.Krohs, H.J.Pohl and L.Schmidt.
Exper. Tech. der Phys., Vol. 5, No. 1, 1-13 (1957). In German.

The characteristics of the Zeiss M12FS scintillation counter tube are described in detail, special attention being given to the variation in overall sensitivity over the cathode surface. The resolving time is considerably better than 10^{-7} sec. A.H.W.Beck

539.1.07

257. RARE-EARTH SOLUTIONS FOR 4π-COUNTING.
J.Pascual and E.C.Freiling.
Nucleonics, Vol. 15, No. 5, 94 (May, 1957).

Details of the preparation of pure lanthanide, actinide and yttrium solutions using a Dowex-50 column. R.D.Smith

539.1.07

258. A WILSON CLOUD CHAMBER WITH TIME-MARKING OF PARTICLE TRACKS. D.Gabor and B.Hampton.
Nature (London), Vol. 180, 746-9 (Oct. 12, 1957).

A resonating microwave cavity, which also constituted a small cloud-chamber, was operated with an almost uniform h.f. field very near to breakdown in an attempt to time-mark particle tracks. Power was provided by a large magnetron giving 2.2 kV at 3000 Mc/s with a pulse duration of 15 msec. Two α-particle tracks of 1000 photographed in hydrogen show periodic thickenings which are almost certainly due to creation of secondary electrons at points of peak field strength. It would be much easier to mark machine-produced particles using a klystron to provide a higher power input. K.H.Barker

539.1.07

259. CONTINUOUSLY SENSITIVE BUBBLE CHAMBER. R.H.Good.
Phys. Rev., Vol. 107, No. 4, 1201 (Aug. 15, 1957).

Employs a solution of CO_2 in isoamyl acetate contained in a glass beaker. The liquid is saturated with gas at dry-ice temperature and the bottom of the beaker is placed in a bath at -78°C. Heating by means of a coil immersed near the upper surface of the liquid produces a thin layer sensitive to radiation from a Po–Be source. K.H.Barker

ELEMENTARY PARTICLES

539.12

260. MEASUREMENT OF THE ELASTIC SCATTERING OF 1.12 MeV γ-RAYS IN LEAD. E.Hara, J.Banaigs and E.Alexandre.
C.R. Acad. Sci. (Paris), Vol. 245, No. 11, 963-5 (Sept. 9, 1957). In French.

The differential cross-section for the elastic scattering of Zn^{65} γ-radiation by Pb was measured at angles between 20° and 115° and found to agree with semi-empirical calculations based on Rayleigh

and Thomson scattering. Disagreement with theory obtained in earlier experiments (Abstr. 6570/1957) using Co^{60} γ-radiation (1.17 MeV) is attributed to inelastic scattering of the 1.33 MeV γ-radiation by bound electrons. M.A.Grace

539.12

261. GAMMA-RAY ABSORPTION COEFFICIENTS FOR Co^{60}. B.D.Nagesvara Rao and S.Jnanananda.
J. sci. industr. Res., Vol. 16B, No. 8, 325-7 (Aug., 1957).

Absorption coefficients of γ-rays of energies 1.1715 and 1.3316 MeV from a 17.1 Mc source (Co^{60}) were measured in copper, zinc, tin, lead and mercury absorbers. Based on the geometry of Davisson and Evans, the apparatus was constructed with fine adjustments for accurate collimation. The absorption coefficient values for copper, zinc and tin show agreement with theoretical values within 0.6-1.9%. The values for lead and mercury are 2.7 and 4.4% respectively less than theoretical values, confirming the deviations previously observed by workers with heavy elements. No probable experimental reason for deviations as large as these could be found. A part of the deviations has, therefore, been ascribed to an insufficiency in theoretical calculation of photoelectric cross-section. A.

539.12

262. PHOTOGRAPHIC EVIDENCE FOR THE EXISTENCE OF THE NEUTRINO. J.Csikai.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1011-12 (April, 1957).

Stereo photographs were taken in a cloud chamber of the decay process $He^6 \rightarrow Li^6 + \beta^- + \nu + 3.6$ MeV, and they show clearly that the recoil track of the Li^6 nucleus is not generally at 180° to that of the electron. L.Pincherle

539.12

263. A POSSIBLE DISSYMMETRY BETWEEN ELECTRON AND POSITRON. B.Jouvet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1397-8 (Oct. 21, 1957). In French.

A suggestion that positrons might be quantized with Bose statistics. R.J.N.Phillips

539.12

264. FOURTH ORDER MAGNETIC MOMENT OF THE ELECTRON. A.Petermann.
Helv. phys. Acta, Vol. 30, No. 5, 407-8 (1957).

Reports the results of analytic calculations of fourth-order corrections to the electron magnetic moment, which differ from those of the original calculation by Karplus and Knoll (Abstr. 3776/1950). J.W.G.Wignall

539.12 : 539.165

265. DOUBLE SCATTERING OF β PARTICLES. L.J.Tassie.
Phys. Rev., Vol. 107, No. 5, 1452-3 (Sept. 1, 1957).

It is pointed out that the polarization of β-particles from randomly oriented radioactive nuclei can be observed in experiments on double scattering of β-particles. Calculations of asymmetries from double scattering from Hg and Au are given. L.L.Green

539.12

266. RANGE STRAGGLING OF HIGH-ENERGY ELECTRONS IN CARBON. J.E.Leiss, S.Penner and C.S.Robinson.
Phys. Rev., Vol. 107, No. 6, 1544-8 (Sept. 15, 1957).

Approximate range-straggling curves for the slowing down of high-energy electrons in carbon are calculated by a Monte Carlo technique using a digital computer. The effects of ionization straggling, radiation, and multiple scattering are included. Calculations are made for incident electron energies from 5 to 55 MeV. A.

539.12

267. INVESTIGATION OF AN ELECTROMAGNETIC CASCADE OF VERY HIGH ENERGY IN THE FIRST STAGE OF ITS DEVELOPMENT. M.Miesowicz, O.Stanisz and W.Wolter.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 513-16 (Feb., 1957).

Gives complete measurements on 14 electron-pairs constituting the initial development of a cascade probably initiated by a photon of about 10^{12} eV. Compared with the predictions of cascade theory there is a significant deficit of electrons with $E \leq 5 \times 10^8$ eV at a depth of 1.55 radiation lengths. This observation is in qualitative agreement with the suggestions of Dyson on the basis of the theories of Ter-Mikaelian and Landau and Pomeranchuk. K.H.Barker

539.12

268. ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS IN NUCLEON–PHOTON INTERACTION. S.N.Gupta.
Phys. Rev., Vol. 107, No. 5, 1442-5 (Sept. 1, 1957).

The validity of the usual phenomenological treatment of the anamalous magnetic moments of nucleons is investigated for processes involving nucleon–photon interaction. By using the charge-symmetrical pseudoscalar meson theory with pseudoscalar coupling, it is shown that the phenomenological treatment completely breaks down for photon energies of a few hundred MeV in the rest system of the nucleon. A.

539.12

269. A PHASE-SHIFT ANALYSIS OF NUCLEON–NUCLEON SCATTERING AT 95 MeV. R.J.N.Phillips.
Proc. Phys. Soc. A, Vol. 70, Pt 10, 721-8 (Oct., 1957).

A phase-shift analysis of n–p and p–p cross-sections and polarizations at 95 MeV is made in terms of S, P and D partial waves. Three distinct small regions in the phase-shift space are found to be able to account for the data, at least approximately. Although the results indicate that F-wave effects are significant at this energy, test calculations suggest that they may be considered as a small perturbation. A.

539.12

270. p–p TRIPLE SCATTERING PREDICTIONS AT 100-170 MeV. J.L.Gammel and R.M.Thaler.
Phys. Rev., Vol. 108, No. 1, 163-4 (Oct. 1, 1957).

Angular distributions of the parameters measurable in triple scattering (the depolarization, the rotation of polarization and the asymmetry) are calculated from the empirical nucleon–nucleon interaction proposed previously by the authors. The validity of the assumptions leading to this interaction would be tested by comparison of the predictions with experimental results, as they become available. D.R.Chick

539.12

271. MULTIPLE SCATTERING MEASUREMENTS ON HIGH ENERGY PROTONS WITH LONG CELL LENGTHS.
S.Biswas, N.D.Prasad and S.Mitra.
Proc. Indian Acad. Sci. A, Vol. 46, No. 2, 167-81 (Aug., 1957).

Scattering measurements on individual tracks and relative-scattering measurements on pairs of tracks have been made in two stacks exposed to 6.2 and 5.7 BeV protons respectively from the Berkeley bevatron. Spurious scattering was determined in these two stacks for cell lengths ranging from 1 mm to 8 mm. In one stack the magnitude of spurious scattering was very low, while in the other it was fairly high. The results indicate that: (a) Spurious scattering varies with cell length t, as t^x, where x is about 0.8 for t = 1 mm to 3 mm and about 0.5 for t = 3 mm to 8 mm. (b) The spurious scattering is lowest near the glass surface of the emulsion and increases towards the air surface. (c) The small-scale dislocations which give rise to spurious scattering extend in the plane of the emulsion at least over distances of 200 μ, but vary rapidly in size and direction with depth. Therefore, reliable relative-scattering measurements require that the separation between the tracks in the depth of emulsion should be as small as possible ($\leq 50\,\mu$) whereas the separation in the plane of the emulsion may be as large as 200 μ. The scattering constant for cell lengths of 1 mm to 8 mm has been determined. The values are about 10% higher than the theoretical values, on the assumption that the proton energy in the bevatron was known accurately at the time the plates were exposed. A.

539.12

272. FURTHER RESULTS ON ANTIPROTON ANNIHILATIONS. E.Amaldi, C.Castagnoli, M.Ferro-Luzzi, C.Franzinetti and A.Manfredini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1797-800 (June, 1957).

A stack of nuclear emulsions was exposed to the 700 MeV/c antiproton beam of the Berkeley Bevatron using the same geometry as in previous work (Abstr. 3787, 4637/1956). Details are given of 14 events attributed to antiprotons. Of these, four annihilate at rest, five annihilate in flight and five produce a star. In a total length of 126.65 cm of antiproton track at energies between 50 and 200 MeV only five small-angle scatterings (about 2°-3°) were found. E.J.Burge

539.12

273. ON THE PRINCIPLE OF INVARIANT IMBEDDING AND ONE-DIMENSIONAL NEUTRON MULTIPLICATION.
R.Bellman, R.Kalaba and G.M.Wing.
Proc. Nat. Acad. Sci. U.S.A., Vol. 43, No. 6, 517-20 (June, 1957).

A new method employing the principle of invariant imbedding is applied to one-dimensional time-independent problems in neutron transport theory. The partial differential equations for the generating functions of the neutron probability distribution and the ordinary differential equations for the moments are obtained for both the one and two-velocity cases. G.Stephenson

539.12

274. THE ENERGY SPECTRUM OF THE 350 MeV NEUTRON BEAM FROM THE LIVERPOOL SYNCHROCYCLOTRON.
A.Ashmore, R.G.Jarvis, D.S.Mather and S.K.Sen.
Proc. Phys. Soc. A, Vol. 70, Pt 10, 735-44 (Oct., 1957).

A knowledge of the energy spectrum of the neutron beam from the 156 inch cyclotron was required for cross-section measurements. The spectrum of the recoil protons produced in n–p collisions was measured with a counter telescope containing a copper absorber of variable thickness. A calibration run was made in the external proton beam to measure the transmission of the absorber as a function of proton energy. It was found that the shape of the spectrum was consistent with the assumption that the neutrons are produced in "elastic" proton–neutron collisions in the beryllium target. The shape is then determined by the amplitude of radial oscillations in the cyclotron and the energy lost by the protons in their multiple traversals of the target. A.

539.12

275. DEVELOPMENT OF A THERMAL-NEUTRON FLUX-MEASURING INSTRUMENT.
C.V.Weaver, C.K.Smith and J.W.Chastain.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 573-7 (1957) = Commun. and Electronics, No. 33 (Nov., 1957).

The instrument measures thermal-neutron flux directly and automatically. Measurements are nearly independent of gamma flux and ambient temperature. The method depends upon balancing the temperatures of an electrically heated balancing element and a fission-heated uranium-fuelled sensing element. The flux-detector assembly measures only 3/16 inch outside diameter by 2¼ inches long. A.

539.12

276. ON THE DERIVATION OF LOW'S EQUATIONS IN THE THEORY OF SCATTERING OF MESONS. A.M.Brodskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 616-17 (1957). In Russian.

A new derivation of Low's equations (Abstr. 3453/1955 and 2680/1956) is given. S.Chomet

539.12

277. LONGITUDINAL POLARIZATION OF THE POSITRONS FROM THE DECAY OF UNPOLARIZED POSITIVE MUONS.
G.Culligan, S.G.F.Frank, J.R.Holt, J.C.Kluyver and T.Massam.
Nature (London), Vol. 180, 751-2 (Oct. 12, 1957).

Describes an experiment to test the two-component neutrino theory with lepton conservation. The polarization was determined by the method of Goldhaber, Grodzins and Sunyar (Abstr. 7159/1957) and found to be predominantly right-handed, whereas the theory predicts left-handed positrons. The scheme can be saved if the beta-decay interaction has been wrongly identified. E.J.Burge

539.12

278. EXPERIMENTAL μ^--CAPTURE RATES: EVIDENCE ON EXCLUSION PRINCIPLE EFFECTS AND THE TYPE OF INTERACTION.
J.C.Sens, R.A.Swanson, V.L.Telegdi and D.D.Yovanovitch.
Phys. Rev., Vol. 107, No. 5, 1464-5 (Sept. 1, 1957).

μ^--capture rates were measured in nuclei throughout the periodic table. The dependence of the capture rates on the form of interaction and specific nuclear properties is discussed.

L.L.Green

539.12

279. RADIATIVE BETA-DECAY OF THE PION.
J.M.Cassels, M.Rigby, A.M.Wetherell and J.R.Wormald.
Proc. Phys. Soc. A, Vol. 70, Pt 10, 729-34 (Oct., 1957).

Theoretically about 1 pion in 10^3 is expected to decay by the process $\pi^+ \rightarrow p + n \rightarrow e^+ + \nu + \gamma$, where the first stage is equivalent to a Yukawa reaction and the second to nuclear beta-decay. A search for electron–photon coincidences from stopped positive pions has shown that in fact probably less than 1 pion in 10^8 decays in this way. A.

539.12

280. OBSERVATION OF AN ASYMMETRY IN THE ANGULAR DISTRIBUTION OF $\pi \rightarrow \mu$ DECAY. H.Hulubei, J.Auslander, E.Balea, E.Friedländer, S.Titeica and T.Visky.
C.R. Acad. Sci. (Paris), Vol. 245, No. 13, 1037-9 (Sept. 23, 1957). In French.

3595 $\pi \rightarrow \mu$ decays in emulsions exposed to the synchrocyclotron at Doubna give an asymmetry coefficient $[= 2(N_f - N_b)/(N_f + N_b)]$ of -0.447 ± 0.032. K.H.Barker

539.12

281. SPIN AND PARITY OF THE NEUTRAL PION.
T.Kinoshita and R.F.Peierls.
Phys. Rev., Vol. 108, No. 1, 161-3, (Oct. 1, 1957).

On the basis of results obtained by Yang (Abstr. 4365/1950) expressions are derived for the coincidence rate between two γ-counters as a function of the angle between the production and decay planes of polarized neutral pions. Circular polarization analysers could be used to determine the parity, provided the spin is not zero. K.H.Barker

539.12

282. ON THE NUCLEONS MAGNETIC MOMENTS CONTRIBUTION TO THE RADIATIVE PION-NUCLEON SCATTERING.
B.Bosco.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1361-3 (May, 1957).

This is calculated using the formalism developed by Chew and Low and is found to be very small. J.W.G.Wignall

539.12

283. ASSOCIATED PRODUCTION IN PION–NUCLEON COLLISIONS AND CHARGE INDEPENDENCE. S.Barshay.
Phys. Rev., Vol. 107, No. 5, 1454 (Sept. 1, 1957).

Using Low's method, the equation for the scattering amplitudes for $\Lambda + K$ and $\Sigma + K$ is derived. It is suggested that the failure to explain simultaneously the Σ^0 and Σ^+ angular distributions might be due to a failure of charge independence in associated production.

W.A.Hepner

539.12

284. A DECAY OF A NEGATIVE τ'. S.Nilsson.
Nuclear Physics, Vol. 3, No. 3, 364-6 (May, 1957).

Reports measurements on the decay of a K^-, found in emulsions exposed to the Bevatron, giving a secondary of 52 ± 2 MeV identified as a π-meson. K.H.Barker

539.12

285. IDENTITY AND PARITY OF K MESONS AND THE PARITY OF HYPERONS FROM A STRONG REACTION.
J.Sandweiss and S.Barshay.
Phys. Rev., Vol. 107, No. 3, 913 (Aug. 1, 1957).

It is suggested that light may be thrown on the above problems by a study of the distribution of the angle between the relative momentum of the K-particles and the hyperon momentum in the K^+–K^+ c.m. system in the reactions

$$\begin{aligned} K^+ + p &\rightarrow K^+ + K^+ + \Lambda^0 \\ &\rightarrow K^+ + K^+ + \Sigma^0 \\ &\rightarrow K^+ + K^0 + \Sigma^+. \end{aligned}$$

R.H.W.Johnston

539.12

286. FORWARD–BACKWARD ASYMMETRY IN K–μ–e DECAY. W.G.Holladay.
Phys. Rev., Vol. 107, No. 2, 637-8 (July 15, 1957).

Some consequences of the Sachs classification of light fermions can be experimentally tested by observations on the forward–backward asymmetry in the disintegration of μ-mesons from $K_{\mu 3}$ decays; the asymmetry is expected to have the opposite sign to that for μ-mesons from π-decays. K.H.Barker

539.12

287. ON THE ENERGY SPECTRUM OF μ-MESONS FROM THE $K_{\mu 3}$-DECAY. S.G.Matinyan.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 929-30 (1957). In Russian.

The $K_{\mu 3}$-decay in the presence of derivative coupling between the fields of fermions (μ,ν) and bosons with spin 0 $(K_{\mu 3},\pi)$ is considered. S.Chomet

539.12

288. INTERACTION OF K^+ MESONS IN THE INTERVAL 30-65 MeV. T.F.Hoang, M.F.Kaplon and R.Cester.
Phys. Rev., Vol. 107, No. 6, 1698-708 (Sept. 15, 1957).

A systematic study of the scattering of 1173 definitely identified K_L mesons and 279 τ (including τ') mesons was made in the energy interval 30-65 MeV using photoemulsion exposed to the Berkeley K^+ meson beam. All scatterings of K^+ mesons having a projected angle greater than 2° on the emulsion plane were recorded and analysed. The results of analysis are the following: (1) the interaction properties of the K_L and τ mesons are essentially indistinguishable; (2) the coherent nuclear scattering of K^+ mesons interferes constructively with the Coulomb scattering; (3) in terms of the optical model, the best fit for coherent scattering corresponds to a real potential of $\sim +15$ MeV, and the inelastic scattering gives

an imaginary potential of ~ 3.6 MeV; (4) charge exchange is rare in this energy region: σ(charge exchange)/σ(incoherent) $< 1/10$. A tentative interpretation of the results in terms of states of isotopic spin T = 0 and T = 1 is presented. A discussion is also given on the characteristic features of K^+ stars. A.

539.12

289. PHOTOPRODUCTION OF K^+ MESONS IN HYDROGEN. P.L.Donoho and R.L.Walker.
Phys. Rev., Vol. 107, No. 4, 1198-200 (Aug. 15, 1957).

K^+ mesons were produced in liquid hydrogen by the 1100 MeV bremsstrahlung beam of the C.I.T. synchrotron and identified by momentum selection, time-of-flight measurement and ionization loss in scintillation counters, the particles being focused by a magnetic spectrometer. It was shown that the K-mesons were produced in the reaction $\gamma + p \rightarrow K^+ + \Lambda^0$ rather than $\gamma + p \rightarrow K^+ + n$, and a table of approximate cross-sections is given for values of $\theta_{c.m.}$ between 65° and 110°. K.H.Barker

539.12

290. PHOTOPRODUCTION OF K MESONS IN HYDROGEN. A.Silverman, R.R.Wilson and W.M.Woodward.
Phys. Rev., Vol. 108, No. 2, 501-2 (Oct. 15, 1957).

The differential cross-section at 155° (c.m.) for the production of K^+ mesons by 1080 MeV bremsstrahlung was found to be $(0.89 \pm 0.21) \times 10^{-31}$ cm^2/sterad, with a further 30% estimated systematic error. These results and those of Donoho and Walker (preceding abstract) appear to favour a scalar K-meson with a rather large coupling constant $G_{NK\Lambda}^2/4\pi$ of 3 ± 1. The calculations for a pseudoscalar K-meson are however sensitive to the choice of the anomalous magnetic moment of the Λ^0. E.J.Burge

539.12

291. PHOTOPRODUCTION OF K^+ MESONS FROM POLYETHYLENE. A.B.Clegg, M.P.Ernstene and A.V.Tollestrup.
Phys. Rev., Vol. 107, No. 4, 1200 (Aug. 15, 1957).

Finds a cross-section of $(3 \pm 1) \times 10^{-31}$ cm^2 sterad^{-1} for the production of 140 MeV K^+ mesons (21 identified particles with $\tau = 13.9 \pm 3.1$ mμsec) at 37.5° lab. angle and a bremsstrahlung end-point of 1.1 BeV. The production process: $\gamma + p \rightarrow K + \Lambda^0$ corresponds to $\theta_{c.m.}$ 95° and $E_\gamma = 1.06$ BeV. K.H.Barker

539.12

292. PRODUCTION OF θ^0 FROM AN S-EVENT. M.S.Sinha and N.C.Das.
Trans Bose Res. Inst. Calcutta, Vol. 19, 73-5 (1953-55).

An event in a multiplate cloud chamber is interpreted as the production of an "S-particle" which subsequently decays into a light meson and a θ^0. The suggested mass of the "S-particle" is $(1460 \pm 100)\, m_e$ and the lifetime $< 6.5 \times 10^{-10}$ sec. E.J.Burge

539.12

293. ON THE ASSOCIATED PRODUCTION OF Λ AND θ PARTICLES. I.Yu.Kobzarev and L.B.Okun'.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 933-4 (1957). In Russian.

The precise determination of the ratios of decays to charged particles to decays of all types of θ^0_1 and Λ^0 particles is shown to be of value in distinguishing between different hypotheses as to the nature of the Λ and θ particles. W.O.Lock

539.12

294. A DISCUSSION OF THE POSSIBILITY OF DETECTING ASYMMETRIES IN THE Λ^0-DECAY. G.Morpurgo.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1787-9 (June, 1957).

Gives expressions for: (i) the production angle at which the polarization may be expected to be a maximum; (ii) the maximum amount of asymmetry in the distribution-in-ϕ (angle between plane of production and plane of decay) which may be found if one integrates over all production angles. K.H.Barker

539.12

295. IDENTIFICATION OF PARTICLES FROM A PROBABLE Λ^0-DECAY. M.S.Sinha and N.C.Das.
Trans. Bose Res. Inst. Calcutta, Vol. 19, 61-6 (1953-55).

Ionization and scattering measurements on two tracks in a multiplate cloud chamber led to the identification of a Λ^0 of mass $(2192-2206)\, m_e$ and a Q-value of 41-47 MeV. E.J.Burge

539.12

296. ON PARITY NON-CONSERVATION IN THE DECAY OF STRANGE PARTICLES. N.Dallaporta and F.Ferrari.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1793-6 (June, 1957).

Calculation of angular correlations in hyperon decays assuming that parity is not conserved and that strange particles have indefinite parities. Some special cases are discussed. J.W.G.Wignall

539.12

297. NUCLEAR INTERACTIONS OF LONG-LIVED NEUTRAL STRANGE PARTICLES. R.Ammar, J.I.Friedman, R.Levi-Setti and V.L.Telegdi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 6, 1801-7 (June, 1957).

Preliminary scanning of an emulsion stack ($10 \times 15 \times 3.5$ cm^3) exposed to a beam of neutral particles from the Berkeley Bevatron provided evidence for charge-exchange reactions of long-lived neutral K-mesons. Details are given of neutral stars producing three τ-mesons, two probable K^+-mesons, one K^-, one Σ^+ and four double stars. It is shown that these are unlikely to be neutron stars. This observation of five particles of positive strangeness and at least two, and possibly six of negative strangeness is considered to give strong support for the model of Gell-Mann and Pais (Abstr. 4088/1955) which proposed a coherent mixture of long-lived $\bar{K}^0$ and K^0. E.J.Burge

539.12

298. MAGNETIC MOMENT OF THE DEUTERON AND NUCLEON–NUCLEON SPIN-ORBIT POTENTIALS. H.Feshbach.
Phys. Rev., Vol. 107, No. 6, 1626-7 (Sept. 15, 1957).

The change in the magnetic moment of the deuteron arising from the presence of a spin–orbit potential in the nucleon–nucleon interaction is estimated for two recent proposals. The effects are found to be substantial. A.

NUCLEUS

539.14

299. POSSIBILITY OF HYPERFRAGMENT FORMATION IN K^-–d REACTIONS. A.Pais and S.B.Treiman.
Phys. Rev., Vol. 107, No. 5, 1396-400 (Sept. 1, 1957).

If there exist bound Σ^-–neutron and/or Λ^0–proton systems, the interaction between slow K^--mesons and deuterons may be an effective means for their production. Estimates are given for the ratio Γ of production of bound states to the corresponding free states for the reactions $K^- + d \rightarrow \Sigma^- + n + \pi^+$ or $\Lambda^0 + p + \pi^-$, where the K^- is supposed to be bound in a low-lying atomic orbit. The following connected alternatives must be considered: (1) K^- is scalar or pseudoscalar, (2) the capture takes place from an atomic s- or p-state, (3) the final bound state is ^3S or ^1S. The ^3S and ^1S cases are qualitatively different. Apart from this it turns out that Γ depends mainly on the binding energy of the hyperon–nucleon system and is insensitive to its effective range. If the (Σ^-, n) system is bound in a ^3S-state with an energy ~ 1 MeV, Γ may be anticipated to be of order unity. It is also noted that the reactions in question may yield partially polarized hyperon beams. A.

539.14

300. THE DECOUPLING FACTOR AND THE COLLECTIVE MODEL. J.Yoccoz.
C.R. Acad. Sci. (Paris), Vol. 244, No. 25, 3052-4 (June 17, 1957). In French.

The decoupling factor is calculated in the approximation previously described (Abstr. 1497/1957) for $K = \frac{1}{2}$ nuclei using properly antisymmetrized wave-functions and for a harmonic oscillator potential without spin–orbit coupling. The results are identical with those obtained by the simplified model of Bohr and Mottelson for the same potential indicating that the Pauli principle does not play an important part in the calculation of the decoupling factor. L.L.Green

539.14

301. SPIN–ORBIT COUPLING AND TENSOR FORCES. B.Jancovici.
Phys. Rev., Vol. 107, No. 2, 631-2 (July 15, 1957).

The magnitude of the nuclear spin–orbit coupling arising from tensor internucleon forces is calculated on the basis of the Brueckner many-body theory, and is found to have an algebraic value much smaller than that given by experiment. J.W.G.Wignall

539.14

302. TIME-DEPENDENT HARTREE–FOCK THEORY OF NUCLEAR COLLECTIVE OSCILLATIONS. R.A.Ferrell.
Phys. Rev., Vol. 107, No. 6, 1631-4 (Sept. 15. 1957).

A theory of nuclear collective oscillations is presented which does not involve introducing extra variables and subsidiary conditions. This time-dependent self-consistent field method is applied to the breathing mode of a spherically symmetric nucleus and yields a value for the frequency of oscillation which is more

accurate than that from a previous treatment in terms of one-nucleon excitation, but which becomes identical to the latter in the case of weak nucleon–nucleon interaction. In cases where nucleon exchange can be neglected, the new estimate reduces to the frequency derived from the simple classical theory of a compressible fluid. By means of an electric monopole sum rule which is derived for T = 0 → T = 0 transitions, it is shown that in general the classical formula overestimates the breathing mode frequency. From the sum rule it also follows that the 6.06 MeV 0^+ state in O^{16} is related only indirectly to the breathing mode, which must itself be at a higher excitation energy. A.

539.14

303. COMPARISON OF THE MIRROR NUCLEI Mg^{25} AND Al^{25}.
H.E.Gove and A.E.Litherland.
Phys. Rev., Vol. 107, No. 5, 1458-9 (Sept. 1, 1957).

The present state of knowledge on the mirror pair Mg^{25}, Al^{25} is summarized and discussed. The properties of these nuclei are well described in terms of the collective model assuming a single particle moving in a spheroidal potential. L.L.Green

539.14

304. BINDING ENERGIES OF HEAVY NUCLEI.
R.Thieberger and A.de-Shalit.
Phys. Rev., Vol. 108, No. 2, 378-83 (Oct. 15, 1957).

Nuclear binding energies of heavy nuclei are calculated from a general two-body interaction by using j-j coupling shell-model wave-functions for the nucleons. The formula obtained can be made to fit experimental data with a high accuracy. A.

539.14

305. COULOMB EXCITATION OF IRON-57.
G.F.Pieper and N.P.Heydenburg.
Phys. Rev., Vol. 107, No. 5, 1300-2 (Sept. 1, 1957).

Coulomb excitation experiments confirmed the existence of excited states in Fe^{57} at 14, 137, and 365 keV. Gamma-rays of energies 123, 228, and 350 keV were observed and their multipolarities determined. A level scheme incorporating these radiations with earlier information is proposed: ground state, $1/2^-$; 14 keV state, $3/2^-$; 137 keV state, $5/2^-$; and 365 keV state, $5/2^-$. The reduced upward transition probabilities, B(E2), in units of $e^2 \times 10^{-48}$ cm^4, for the two states excited are: 137 keV level, 0.050; 365 keV level, 0.033. A.

539.14

306. PRECISION DETERMINATION OF THE LOW-LYING ENERGY LEVELS OF W^{182}, W^{183}, W^{184}, AND W^{186}.
E.L.Chupp, A.F.Clark, J.W.M.DuMond, F.J.Gordon and H.Mark.
Phys. Rev., Vol. 107, No. 3, 745-50 (Aug. 1, 1957).

The low-lying energy levels in the tungsten isotopes was studied by using the 3.7 MeV proton beam of a high-current linear accelerator to excite the nuclei. The large beam-currents available make it possible to use a bent-quartz-crystal spectrograph to observe the resultant γ-rays. With such an instrument, a resolution of better than 0.1% is possible. The following γ-rays were observed: W^{182}, 100.07 ± 0.05 keV; W^{183}, 46.508 ± 0.03 keV and 52.612 ± 0.030 keV; W^{184}, 111.13 ± 0.06 keV; W^{186}, 122.48 ± 0.08 keV. (Energies relative to W K-series X-rays). The isotopic assignments are known from previous work on these lines. Known wavelengths of the K-series X-rays of tungsten and certain nuclear lines were used to calibrate the plate. A.

539.14

307. NUCLEAR ENERGY LEVELS EXCITED BY FAST NEUTRONS. R.M.Sinclair.
Phys. Rev., Vol. 107, No. 5, 1306-10 (Sept. 1, 1957).

Fast-neutron inelastic scattering was studied in a number of elements by observation of the de-excitation gamma-rays with a single-crystal NaI(Tl) spectrometer. Neutrons of energy 4.4 ± 0.1 MeV were used to bombard isotopically enriched scatterers of Ti, Cr, Ni, Zn, Ge, and W, and normal scatterers of Cl, Sr, Nb, Nd, Sm, and Gd. The low-lying levels in Ti^{47}, I, and W are studied using neutron energies between 0.50 MeV and 1.45 MeV. Energies and relative yields of the gamma-rays are given, and their assignment to various excited states is discussed. Previously unknown states were found in Ti^{48}, Cr^{50}, Zn^{64}, Zn^{66} and Ge^{74}. A.

539.14

308. ENERGY LEVELS IN FLUORINE-19 NUCLEUS.
A.Hossain and A.N.Kamal.
Phys. Rev., Vol. 108, No. 2, 390-2 (Oct. 15, 1957).

Nuclear emulsion technique was employed to determine the energy levels in F^{19} with the help of an incident proton beam of 9.5 MeV energy from the Birmingham cyclotron. Energy levels in F^{19} were obtained at 1.36 ± 0.02, 1.55 ± 0.01, 2.83 ± 0.02, 3.92 ± 0.04, 4.06 ± 0.05, 4.57 ± 0.02, 4.76 ± 0.05, 5.27 ± 0.02, 5.53 ± 0.03 and 6.07 ± 0.02 MeV. In addition, possible levels at 4.95 ± 0.02 and 6.50 ± 0.09 MeV were detected. A.

539.14

309. COBALT NUCLEAR RESONANCE SPECTRA.
R.Freeman, G.R.Murray and R.E.Richards.
Proc. Roy. Soc. A, Vol. 242, 455-66 (Nov. 19, 1957).

The frequencies of the cobalt nuclear resonances of solutions of cobalt (III) complexes have been measured in a magnetic field of 4370.9G. The temperature coefficient of the nuclear resonance frequency of two of the complexes has been measured, and the effect of variation of solvent studied. The electronic absorption spectra of the complexes have also been measured, and the absorption band shifts which occur when the temperature is changed have been studied for two of the complexes. The nuclear resonance frequencies show a close correlation with the spectrochemical series of the ligands. Following a suggestion by Orgel, a simple interpretation of the chemical shifts is developed in terms of crystal field theory. The theory predicts a linear relation between the cobalt nuclear resonance frequency and the wavelength of the lowest frequency optical absorption maximum of the octahedral complexes. The compounds studied support this prediction. Using measured values of the temperature coefficient of the nuclear resonance frequency and the optical absorption wavelength, the theory permits the temperature dependence of the optical spectrum to be calculated. In the two cases studied the calculations are in satisfactory agreement with experiment. The results provide information about the "electronic shielding" of the cobalt nucleus which leads to an improved value of the cobalt nuclear moment. A.

539.14

310. PARAMAGNETIC RESONANCE HYPERFINE STRUCTURE OF Ce^{141} AND Nd^{147}. R.W.Kedzie, M.Abraham and C.D.Jeffries.
Phys. Rev., Vol. 108, No. 1, 54-7 (Oct. 1, 1957).

The microwave paramagnetic resonance hyperfine structures of 33 day Ce^{141} and 11 day Nd^{147} were observed in a single crystal of $La_2Mg_3(NO_3)_{12}.24H_2O$ at 4.2°K. From the number of h.f.s. lines the nuclear spins were found directly to be $I(Ce^{141}) = 7/2$ and $I(Nd^{147}) = 5/2$. The magnetic hyperfine coupling constants are found to be $B(Ce^{141}) = 0.0126 \pm 0.0001$ cm^{-1}, and $B(Nd^{147}) =$ $= 0.0237 \pm 0.0001$ cm^{-1}. From these the nuclear magnetic moments are calculated to be $|\mu(Ce^{141})| = 0.89 \pm 0.09$ nm, and $|\mu(Nd^{147})| =$ $= 0.542|\mu(Nd^{143})| = 0.56 \pm 0.06$ nm. These results are discussed in relation to those of the shell model and nuclear alignment experiments. A.

539.14

311. SPIN AND MAGNETIC MOMENT OF Eu^{152} AND Eu^{154} BY PARAMAGNETIC RESONANCE.
M.Abraham, R.Kedzie and C.D.Jeffries.
Phys. Rev., Vol. 108, No. 1, 58-9 (Oct. 1, 1957).

The microwave paramagnetic resonance hyperfine structures of 13 year Eu^{152} and 15 year Eu^{154} were observed in a sample of Eu^{3+} which was incorporated in a KCl powder. From the number of h.f.s. lines the spins were found to be $I(Eu^{152}) = 3$ and $I(Eu^{154}) = 3$. Neglecting h.f.s. anomalies, from the ratios of the total h.f.s. splitting these magnetic moment ratios were obtained: $|\mu(Eu^{154})|/|\mu(Eu^{153})| =$ $= 1.308 \pm 0.004$, $|\mu(Eu^{152})|/|\mu(Eu^{151})| = 0.5574 \pm 0.006$, $|\mu(Eu^{151})|/|\mu(Eu^{153})| = 2.264 \pm 0.006$. Using $\mu(Eu^{153}) \cong 1.6$ nm, it was found that $|\mu(Eu^{154})| \cong 2.1$ nm and $|\mu(Eu^{152})| \cong 2.0$ nm. These results are discussed in relation to the nuclear shell model. A.

539.14

312. ON THE NUCLEAR QUADRUPOLE MOMENT OF Mn^{55}.
G.Nöldeke and H.Rottmann.
Naturwissenschaften, Vol. 44, No. 17, 464 (Sept. 15, 1957).
In German.

Optical hyperfine structure measurements give this as $(0.3 \pm 0.1) \times 10^{-24}$ cm^2. J.W.G.Wignall

539.14

313. COLLECTIVE EFFECTS IN O^{17}. B.J.Raz.
Phys. Rev., Vol. 107, No. 4, 1201-2 (Aug. 15, 1957).

The quadrupole moment of the ground state of O^{17}, calculated from the lifetime of the first excited state by applying the weak-coupling collective model, agrees well with a recent experimental redetermination. D.R.Chick

539.14

314. MAGNETIC MOMENT OF Ne^{21}.
J.T.LaTourrette, W.E.Quinn and N.F.Ramsey.
Phys. Rev., Vol. 107, No. 4, 1202 (Aug. 15, 1957).

The ratio of the g-values for Ne^{21} and D_2 was measured in a molecular-beam magnetic resonance apparatus employing the separated oscillatory-field method, giving a value of 0.514274 ± 0.000004 without shielding corrections. The sign of the magnetic moment of Ne^{21} was found to be negative, and the spin is stated to be 3/2. These data result in the value $\mu(Ne^{21}) = -0.661758 \pm 0.000005$ nuclear magneton for the nuclear magnetic moment of Ne^{21} including shielding corrections. D.R.Chick

539.14

315. MAGNETIC MOMENT OF 72 DAY Co^{58} BY PARAMAGNETIC RESONANCE. W.Dobrov and C.D.Jeffries.
Phys. Rev., Vol. 108, No. 1, 60-1 (Oct. 1, 1957).

The microwave paramagnetic resonance hyperfine structure of 72 day Co^{58} was observed at 20°K and 3 cm wavelength in a single crystal of $(Zn,Co)K_2(SO_4)_2.6D_2O$. From the spacing of the h.f.s. lines relative to those of Co^{59}, the magnetic moment was found to be $|\mu(Co^{58})| = 4.052 \pm 0.011$ nm, neglecting h.f.s. anomalies. The pattern of lines is consistent with the previously known spin I = 2. A.

RADIOACTIVITY.

539.16 : 539.12

316. RADIATION FROM NEUTRON-ACTIVATED SLABS AND CYLINDERS [DATA SHEET]. W.B.Lewis.
Nucleonics, Vol. 15, No. 4, 84-5 (April, 1957).

The ratio of the radioactive radiation leaving the surface of a slab or cylinder to the total induced by irradiation in a neutron flux is determined in two steps; first the distribution of the activity and then the self-absorption of the radiation. Graphs are given enabling these quantities to be determined to ±10%. R.D.Smith

539.163

317. PRODUCTION OF THE NEW ELEMENT 102.
P.R.Fields, A.M.Friedman, J.Milsted, H.Atterling, W.Forsling, L.W.Holm and B.Astrom.
Phys. Rev., Vol. 107, No. 5, 1460-2 (Sept. 1, 1957).

Bombardment of targets of Cm with C^{13} ions with energies of about 90 MeV leads to the formation of an element with 10 min half-life associated with 8.5 ± 0.1 MeV α-particle emission. Cation exchange column elution identifies this as element 102 for which the name nobelium (No) is proposed. Possible reactions are $Cm^{244}(C^{13},4n)\,102^{253}$ or $Cm^{244}(C^{13},6n)\,102^{251}$. M.A.Grace

539.163.2

318. NUCLEAR DECAY OF Br^{84} AND THE LEVEL SCHEME IN Kr^{84}. N.R.Johnson and G.D.O'Kelley.
Phys. Rev., Vol. 108, No. 1, 82-90 (Oct. 1, 1957).

The decay properties of fission product Br^{84} were studied by scintillation methods. Its half-life was found to be 31.80 ± 0.08 min. Gamma-ray spectra showed gamma-rays of energy 0.27, 0.35, 0.43, 0.47, 0.52, 0.61, 0.74, 0.81, 0.879 ± 0.007, 1.01, 1.21, 1.47, 1.57, 1.74, 1.90 ± 0.02, 2.05, 2.17, 2.47 ± 0.03, 2.82, 3.03, 3.28, and 3.93 ± 0.03 MeV. Single-crystal and coincidence spectrometry established beta-ray groups at 4.71, 3.83, 2.80, 1.81, 1.39, and possibly 0.83 MeV. From these data a level scheme in Kr^{84} is formulated with excited levels at 0.88, 1.90, 2.17, 2.36, 2.62, 2.71, 2.91, 3.35, 3.70, 3.91, and 4.18 MeV. The mass difference between the ground state of Br^{84} and Kr^{84} is represented by the 4.71 MeV beta-ray which includes 32% of the beta-ray transitions. A.

539.163.2

319. DECAY OF EUROPIUM-154.
J.O.Juliano and F.S.Stephens, Jr.
Phys. Rev., Vol. 108, No. 2, 341-8 (Oct. 15, 1957).

The gamma-rays and electrons of fission-product europium (Eu^{153}, Eu^{154}, and Eu^{155}) were studied, and the results obtained for Eu^{154} are presented. Gamma-rays belonging to this isotope have been identified at 0.1229 MeV (35%), 0.2480 MeV, 0.593_3 MeV (4%), 0.694_1 MeV (≤ 3.5%), 0.705_8 MeV (≤ 3.5%), 0.724_9 MeV (21%), 0.758_9 MeV (≤ 3.5%), 0.875_3 MeV (13%), 0.998_2 MeV (14%), 1.007 MeV (17%), 1.277 MeV (42%), and ~ 1.6 MeV (~ 3%). Beta end-points of Eu^{154} were measured at 1.85, 0.87, 0.59, and 0.25 MeV. Multipolarities for most of the above gamma-ray transitions are suggested on the basis of the measured K-shell conversion coefficients. The decay scheme of Eu^{154} is deduced, and, in most respects, the resulting levels of Gd^{154} conform well with the Bohr–Mottelson unified nuclear model and with other even–even nuclei in the strong-coupling regions. A.

539.165

320. BETA DECAY OF THULIUM-171.
W.G.Smith, R.L.Robinson, J.H.Hamilton and L.M.Langer.
Phys. Rev., Vol. 107, No. 5, 1314-15 (Sept. 1, 1957).

The radiations emitted in the decay of 1.9 year Tm^{171} were studied with a 180°, 40 cm radius of curvature, shaped magnetic-field spectrometer, a scintillation spectrometer, and a 125 gauss permanent-field spectrograph. Beta–gamma coincidence measurements were also made. Two beta-groups with end-point energies of 96.5 ± 1 keV and ~ 30 keV were observed. A 66.7 ± 0.5 keV transition, probably an M1-E2 mixture, was also observed. Possible spin assignments are discussed. A.

539.165 : 539.12

POLARIZATION OF β-PARTICLES FROM RANDOMLY-ORIENTED RADIOACTIVE NUCLEI. See Abstr. 265

539.165.2

321. ASYMMETRY OF THE POSITON EMISSION BY POLARIZED ^{58}Co NUCLEI. H.Postma, W.J.Huiskamp, A.R.Miedema, M.J.Steenland, H.A.Tolhoek and C.J.Gorter.
Physica, Vol. 23, No. 3, 259-60 (March, 1957).

8 microcuries of Co^{58} were contained in a 0.15 mm layer of $Ce_2Mg_3(NO_3)_{12}.24H_2O$. The nuclear spins could be polarized by the h.f.s. polarization method. At 0.01°K the emission in the direction of the nuclear spins was larger by 12 ± 3% than in the opposite direction. Results are not inconsistent with the two-component neutrino theory. L.Pincherle

539.166

322. THE ANGULAR CORRELATIONS OF THE 199 keV-110 keV AND 178 keV-131 keV γ–γ-CASCADES IN THE γ-SPECTRUM OF Tm^{169}. U.Cappeller and R.Klingelhöfer.
Z. Naturforsch., Vol. 12a, No. 1, 84-5 (Jan., 1957). In German.

These were measured using a γ–γ coincidence scintillation spectrometer (resolving time 6×10^{-9} sec) and the general picture of the levels of Tm^{169} was confirmed; the 178-131 keV cascade is pure M_1, E_2 while the 199-110 keV cascade is $0.8\ M_1 + 0.2\ E_2$, M_1. A.O.Stanesby

NUCLEAR REACTIONS

539.172 : 537.562

323. A POSSIBLE FUSION REACTOR.
G.Miyamoto, G.Iwata, S.Mori and K.Inoue.
J. Phys. Soc. Japan, Vol. 12, No. 4, 438 (April, 1957).

Briefly describes a general spatial arrangement of electrostatic and magnetic fields, arising from a mass-spectrometer study of a system for perfect velocity and 4π directional focusing in which injected particles return repeatedly to a central point. The authors suggest that the effective collision density at this central point may be high enough to produce chain fusion reactions. Loss mechanisms are very briefly described. J.D.Craggs

539.172

324. SPONTANEOUS FISSION NEUTRON SPECTRUM OF Cf^{252}.
A.B.Smith, P.R.Fields and J.H.Roberts.
Phys. Rev., Vol. 108, No. 2, 411-13 (Oct. 15, 1957).

The spontaneous fission neutron spectrum of Cf^{252} from 0.2 to 7.0 MeV was measured. Time-of-flight techniques were employed to determine the lower energy portion of the spectrum while proton recoils in emulsions were used to study the higher energy neutrons. The measured neutron spectrum is, within the experimental accuracy, described by the empirical relation $N(E) \propto \exp[-0.88E(\text{MeV})] \times \sinh[2.0E(\text{MeV})]^{1/2}$, where N(E) is the number of neutrons of energy E per unit energy interval. The experimental results are compared with the theoretically determined Cf^{252} fission neutron spectrum. A.

539.172.1

325. ANGULAR DISTRIBUTION OF N^{13} FROM N^{14} ON Mg^{25}.
M.L.Halbert and A.Zucker.
Phys. Rev., Vol. 108, No. 2, 336-41 (Oct. 15, 1957).

The angular distribution of N^{13} from the neutron-transfer reaction $Mg^{25}(N^{14},N^{13})Mg^{26}$ was measured at an incident nitrogen energy

of 27.9 MeV. N^{13} was caught on aluminium foils placed at various angles around the thin Mg^{26} target. The foils were counted after bombardment and N^{13} was identified by its 10 min half-life. The angular distribution was found to have a maximum at ~65° in the centre-of-mass system, to fall off sharply at forward angles, and to decrease more slowly at angles larger than 65°. The energy spectrum of N^{13} was measured at three angles around 65° (c.m.). It was found that the residual Mg^{26} is left in excited states and that the larger the angle the higher the states in which Mg^{26} is likely to be left. For the transfers leaving Mg^{26} in the ground state, a classical estimate of the distance, D, of closest approach was made. Expressing the result as $D = d_0(A_1^{1/3} + A_2^{1/3})$, $D_0 = 1.9 \times 10^{-13}$ cm at the peak of the angular distribution. Thus, most of these transfers occur when the nuclei are not touching in the usual sense. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172.11

326. ELASTIC SCATTERING OF ALPHA PARTICLES.
D.D.Kerlee, J.S.Blair and G.W.Farwell.
Phys. Rev., Vol. 107, No. 5, 1343-62 (Sept. 1, 1957).

An extensive study of elastic scattering of medium-energy alpha-particles at fixed angles was made for 28 nuclides ranging from Ni to Pu. The sharp-cutoff model is used to evaluate interaction radii, $R_{A\alpha}$, and a simple graphical method has been developed for these evaluations. A least squares fit to the experimental data of the form $R_{A\alpha} = r_0A^{1/3} + b$ gives $r_0 = (1.414 \pm 0.042) \times 10^{-13}$ cm, $b = (2.19 \pm 0.20) \times 10^{-13}$ cm. The internal consistency of the data is much higher than the stated over-all errors (standard deviations) indicate; the average departure from the least squares curve is 0.75%. The dependence of interaction radius upon scattering angle is slight over the range of angles studied. Significant differences in interaction radius are seen between Pb and Bi and between U^{235} and U^{238}, among others. Small changes in either neutron or proton configuration influence the detailed structure of the curves of cross-section v. energy, especially in the region of a closed neutron or proton shell. The angular and energy dependence of the structure in cross-section curves is qualitatively discussed in terms of the sharp-cutoff model. A modification of this theory is used to estimate the cross-section for an ellipsoidally distorted nucleus. A.

539.172.13

327. THE POLARIZATION OF 173 MeV PROTONS INELASTICALLY SCATTERED BY CARBON.
H.Tyrén, P.Hillman and A.Johansson.
Nuclear Physics, Vol. 3, No. 2, 336-9 (April, 1957).

The polarization of 173 MeV protons inelastically scattered from the 4.4 MeV level in C^{12} was measured over a range of angles from 10° to 35°. Protons scattered from the target were magnetically analysed and their polarization measured by means of a thick carbon analyser. This was calibrated using the elastically scattered protons in the angular range 6° to 20° for which accurate polarizations at 137, 155 and 220 MeV are accurately known. The polarization of the inelastically scattered protons agrees with previously published results at 155 and 220 MeV when the angular scale is adjusted by the factor $\sqrt{E/173}$ over the angular range 10° to 35°, as do the elastic scattering results in the angular range 20° to 35°. D.R.Chick

539.172.13

328. INTERACTIONS OF 28 MeV PROTONS WITH HELIUM-4.
A.F.Wickersham, Jr.
Phys. Rev., Vol. 107, No. 4, 1050-5 (Aug. 15, 1957).

When He^4 is bombarded with 28 MeV protons the dominant reaction is elastic scattering, exhibiting a strong peak in the forward direction and a slight rise in the backward direction. The dominant inelastic reaction is the inverse Butler or pickup deuteron process. The two remaining inelastic reactions observed, $He^4(p,2p)H^3$ and $He^4(p,pn)He^3$, have cross-sections of 8.9 ± 1.0 and 4.8 ± 1.3 mb, respectively. These are an order of magnitude or more smaller than the cross-sections of the dominant processes. Of the remaining possible reactions — (p,pd), (p,n2p), (p,pγ) — only the last was energetically possible at the beam energy used. It was not observed. This indicates a lack of evidence for an excited level that decays principally by γ-ray emission; it also indicates that the inverse photodisintegration process, suggested by Flowers and Mandl, has too small a cross-section to contribute in this energy region. The rest-frame momentum spectrum of protons from the $He^4(p,2p)H^3$ reaction shows no evidence of an excited level in He^4 in the energy region explored. A.

539.172.13

329. NUCLEAR ENERGY LEVELS IN O^{16}, O^{18}, AND F^{19}.
T.E.Young, G.C.Phillips and R.R.Spencer.
Phys. Rev., Vol. 108, No. 1, 72-4 (Oct. 1, 1957).

Thin targets of F^{19} and O^{18} were bombarded with protons of approximately 5 MeV from a Van de Graaff accelerator. Excited states were observed at 1.344 ± 0.005, 1.458 ± 0.005, and 1.554 ± ± 0.005 MeV in F^{19}, and at 1.981 ± 0.004 MeV in O^{18}. Q values for the $F^{19}(p,\alpha)O^{16}$ reaction were determined to be 2.061 ± 0.015, 1.981 ± 0.008, 1.193 ± 0.008, 0.997 ± 0.008, and −0.763 ± 0.008 MeV. A.

539.172.13

330. PROTON–NUCLEUS SCATTERING AT 17 MeV.
A.E.Glassgold and P.J.Kellogg.
Phys. Rev., Vol. 107, No. 5, 1372-80 (Sept. 1, 1957).

Previous studies (Abstr. 7377/1957) are extended to 17 MeV. As at 10 MeV, it is difficult to obtain unique sets of parameters because of the similar effects of the real part of the potential V and the interaction radius R, on the one hand, and the imaginary part of the potential W and the diffuseness parameter a, on the other. If the best half-way radius for each element is expressed as $R = r_0A^{1/2} \times 10^{-13}$ cm, r_0 decreases from $r_0 = 1.29$ for light and medium elements to $r_0 = 1.22$ for heavy elements. Values for the diffuseness parameter near $a = 0.5 \times 10^{-13}$ cm are used. Normalized to $r_0 = 1.30$ the average value of the optical-model potential at this energy is −(50 + i8) MeV. Values of the reaction cross-section are given. An analysis of proton–carbon scattering from 14 to 20 MeV is presented. It is also shown that proton–nucleus scattering at this energy is sensitive to the precise details of the potential in the central and surface regions. In addition the scattering is independent of the shape of the nuclear charge density for energies up to 100 MeV. A.

539.172.13

331. INELASTIC SCATTERING OF PROTONS FROM Cu^{65}, Ni^{58}, Ni^{60}, AND Ni^{62}. R.R.Spencer, G.C.Phillips and T.E.Young.
Phys. Rev., Vol. 108, No. 1, 69-71 (Oct. 1, 1957).

A 180° magnetic spectrometer was used in measuring the energies of inelastically scattered protons from targets of natural nickel and from targets enriched in the isotopes Ni^{58}, Ni^{60}, Ni^{62}, and Cu^{65}. Energy levels below 3.09 MeV excitation in Ni^{58}, Ni^{60}, and Ni^{62} and below 1.64 MeV excitation in Cu^{65} were determined. A.

539.172.13

332. THE ELASTIC SCATTERING OF PROTONS BY CARBON, ALUMINIUM, NICKEL, COPPER, ZINC, NIOBIUM, SILVER AND GOLD. G.W.Greenlees, L.G.Kuo and M.Petravić.
Proc. Roy. Soc. A, Vol. 243, 206-16 (Dec. 24, 1957).

Absolute differential cross-sections have been measured at 10° intervals for the elastic scattering of protons of energy 9.37 ± ± 0.07 MeV from eight elements: C, Al, Ni, Cu, Zn, Nb, Ag and Au. In addition, measurements have been made for Al at 9.06, 8.86, 8.61 and 8.11 MeV. The scattering chamber permitted observations to be made in the angular range 15 to 165° (laboratory coordinates) and the scattered protons were detected using a CsI:Tl crystal and photomultiplier arrangement with an energy resolution of 3%. The estimated error of each differential cross-section given is ±3%. The angular distributions show characteristic maxima and minima and vary smoothly with target mass number and energy. A.

539.172.13

333. THE SCATTERING OF 9.5 MeV PROTONS BY He, C, N, O, F, Ne, A, Kr AND Xe NUCLEI.
W.M.Gibson, D.J.Prowse and J.Rotblat.
Proc. Roy. Soc. A, Vol. 243, 237-51 (Dec. 24, 1957).

A nuclear emulsion method for studying scattering and nuclear reactions of particles from the Nuffield cyclotron of the University of Birmingham, in gaseous targets, is presented. This method has been developed from that described by Burrows, Powell and Rotblat (1951). The differential cross-sections for elastic scattering of 9.5 MeV protons by He, C, N, O, F, Ne, A, Kr and Xe have been measured, and the results for all except Kr and Xe are discussed in terms of the optical model. Results for carbon obtained at four energies between 9.37 MeV and 9.58 MeV show marked dependence on energy. Differential cross-sections for inelastic scattering of 9.5 MeV protons from C, N, Ne, A and F are also presented and discussed. A.

539.172.13 : 539.12

334. ON REACTIONS CATALYSED BY μ-MESONS IN HYDROGEN. Ya.B.Zel'dovich and A.D.Sakharov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 947-9 (1957). In Russian.

It is shown that in the $p + d \rightarrow He^3$ reaction (Abstr. 6614/1957

and 5651/1957) the probability of the process occurring with the excess energy carried off by a meson, and the probability of its occurring with the emission of a γ-quantum are both of the order of unity during the lifetime of the meson. S.Chomet

539.172.13

335. STUDY OF REACTION MECHANISMS INVOLVED IN THE $Ca^{40}(d,p)Ca^{41}$ REACTION. L.L.Lee, Jr and J.P.Schiffer.
Phys. Rev., Vol. 107, No. 5, 1340-2 (Sept. 1, 1957).

Excitation functions and angular distributions for the $Ca^{40}(d,p)Ca^{41}$ (ground state) reaction were measured from 1.50 to 4.15 MeV bombarding energy. Strong resonance effects are observed in the excitation functions, indicating that at least 20% of the reaction proceeds through compound-nucleus formation. Angular distributions were measured at 7.5° intervals between 0° and 157.5° in the laboratory system. Although these show strong fluctuations over resonances, a general forward peaking is apparent throughout the energy region studied. A.

539.172.13

336. ANGULAR DISTRIBUTIONS OF NEUTRONS FROM $Al^{27}(d,n)Si^{28}$. A.G.Rubin.
Phys. Rev., Vol. 108, No. 1, 62-8 (Oct. 1, 1957).

By using the method of proton recoils in nuclear emulsions, angular distributions of neutrons emitted to low-lying states of Si^{28} in the reaction $Al^{27}(d,n)Si^{28}$ were obtained at deuteron energies of 2.16 and 6.00 MeV. As might be expected, the angular distributions obtained at E_d = 2.16 MeV show considerable deviations from the predictions of the simple Butler stripping theory. The angular distributions obtained at E_d = 6.00 MeV are analyzed by means of the Butler theory to obtain parities and limits on the spins of Si^{28} states. These results are, for the ground state, $J^\pi = 0^+, 1^+, 4^+$, or 5^+; 1.78 MeV state, $J^\pi = 2^+$ or 3^+; 4.62 MeV state, $J^\pi = 1^-$ to 4^-; 6.24 MeV state, $J^\pi = 2^+$ or 3^+; 6.88 MeV state, $J^\pi = (1^-$ to $4^-)$; 7.90 MeV state, $J^\pi = 2^+$ or 3^+; 8.57 MeV state, $J^\pi = 2^+$ or 3^+; 9.39 MeV state, $J^\pi = 2^+$ or 3^+. It is pointed out that the odd parity of the 4.62 MeV state of Si^{28} is consistent with the possible shell-model states of a spheroidal nucleus. A.

539.172.13

337. IMPULSE APPROXIMATION FOR STRIPPING REACTIONS. W.Tobocman.
Phys. Rev., Vol. 108, No. 1, 74-6 (Oct. 1, 1957).

It is found that the first term of the impulse expansion for the stripping problem is identical with the first term of the Born expansion. It is suggested that the impulse approximation argument may provide a better justification for the usual treatment of stripping and pickup reactions than does the Born approximation argument. A.

539.172.3

338. THE DISTRIBUTIONS IN ANGLE AND ENERGY OF THE PHOTOPROTONS FROM THE PROCESS $A^{40}(\gamma,p)Cl^{39}$. F.Gudden and J.Eichler.
Naturwissenschaften, Vol. 44, No. 19, 508-9 (1957). In German.

These were measured in a Wilson chamber using the bremsstrahlung from a pulsed 15 MeV betatron: the energy distribution has sharp maxima at 0.713 ± 0.01 and 0.837 ± 0.01 MeV; the angular distribution is pure $\sin^2\theta$: $I(\theta) = 0.031 + \sin^2\theta$. A.O.Stanesby

539.172.3

339. EVIDENCE OF A SECOND MAXIMUM IN THE CROSS SECTION FOR FAST PHOTONEUTRON EMISSION IN Cr, As, I, Ta. F.Ferrero, R.Malvano and C.Tribuno.
Nuovo Cimento, Vol. 6, No. 2, 385-6 (Aug., 1957).

The fast photoneutron yield curves for 25 elements with atomic numbers between 13 and 82 were measured using the X-ray beam from a 30 MeV betatron. Second maxima were observed in the yield curves of chromium, arsenic, indium and tantalum. These elements occur in nature substantially as single isotopes. Many of the other targets contained several isotopes and second maxima from individual isotopes would be obscured. D.R.Chick

539.172.3

340. MIGDAL'S AND KHOKHLOV'S CALCULATIONS OF THE NUCLEAR PHOTOEFFECT. J.S.Levinger.
Phys. Rev., Vol. 107, No. 2, 554-8 (July 15, 1957).

Migdal's calculation of $\sigma_{-2} = \int \sigma W^{-2} dW$ is compared with experimental data on the nuclear photoeffect. The experimental data for seven nuclei from Al to U agree with the equation $\sigma_{-2} = 3.5 A^{5/3} \mu b/MeV$; while Migdal's calculation gives an equation of this form, but with a smaller coefficient. It is shown that Migdal's calculation gives a mean energy $(\sigma_{int}/\sigma_{-2})^{1/2}$ in essential agreement with Jensen's two-fluid model calculation of the resonance energy. Khokhlov's and Levinger's calculations are then compared of the bremsstrahlung-weighted cross-section σ_b for a finite square well with each other, and with experimental data, and agreement is found with the equation $\sigma_b = 0.30 A^{4/3}$ mb. In the appendix a very simple calculation is given of the polarizability α of the deuteron, with the result $\alpha = 0.64 \times 10^{-39}$ cm^3. A.

539.172.3

341. RELATION OF THE DEUTERON PHOTODISINTEGRATION CROSS SECTION TO THE NEUTRON–PROTON FORCE. R.G.Newton.
Phys. Rev., Vol. 107, No. 4, 1025-7 (Aug. 15, 1957).

It is shown that for a very general class of neutron–proton triplet S-phase shifts, given as functions of the energy, the experimental deuteron photodisintegration cross-section singles out the neutron–proton central triplet potential with the shortest exponential tail. It is therefore powerful evidence for a short decay length of this potential, evidence which is unobtainable from the low-energy scattering data and the binding energy alone. A.

539.172.3

342. PHOTONEUTRONS FROM LEAD. M.E.Toms and W.E.Stephens.
Phys. Rev., Vol. 108, No. 1, 77-81 (Oct. 1, 1957).

The photoneutrons ejected from a small lead target by 23 MeV bremsstrahlung X-rays from a betatron were observed by means of recoil protons in nuclear emulsions. The angular distribution of the more energetic photoneutrons was nearly isotropic. The yield, in units of 10^7 neutrons per mole-roentgen, was 1.4 ± 0.2. The observed energy distribution had its maximum near 1.75 MeV. A yield curve for photoneutrons was obtained using neutron counters in paraffin. A cross-section curve was derived from the yield curve with a normalization based on the nuclear-emulsion data. The calculated energy distribution which gave a satisfactory fit to the observed photoneutrons consisted of 90% "evaporation" from a compound nucleus and 10% emission by the "resonance" direct effect. In calculating the contribution of "evaporated" neutrons a nuclear "temperature" for the residual nucleus of 1.35 MeV was used, and the factors for transmission of l = 0 neutrons through a centrifugal barrier were applied. A.

539.172.3

343. NUCLEAR PHOTOEFFECT IN Be^9 AT HIGH ENERGIES. T.I.Kopaleishvili.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1249-50 (1957). In Russian.

The total cross-section, σ, for photoemission of neutrons from Be^9 is considered theoretically. Überall (Abstr. 5071/1953) calculated the total cross-section as a function of γ-energy from 20 to 200 MeV, the resulting curve showing a series of peaks. A continuously falling curve of σ against energy is obtained which agrees well with experiment. J.H.Fremlin

539.172.4 : 539.172.11

344. INTERACTION OF NEUTRONS WITH OXYGEN AND A STUDY OF THE $C^{13}(\alpha,n)O^{16}$ REACTION. R.B.Walton, J.D.Clement and F.Boreli.
Phys. Rev., Vol. 107, No. 4, 1065-75 (Aug. 15, 1957).

Measurements of the oxygen total neutron cross-section from 3.5 to 4.4 MeV and the $O^{16}(n,\alpha)C^{13}$ reaction cross-section from 4.0 to 5.2 MeV are presented. In a study of the $C^{13}(\alpha,n)O^{16}$ reaction the following quantities were measured: the 0° yield from 0.8 to 3.5 MeV, 29° and 146° yields between 2.0 and 3.5 MeV, and 47 angular distributions in the range from 1.0 to 3.5 MeV. Cross-sections for the $O^{16}(n,\alpha)C^{13}$ and the $C^{13}(\alpha,n)O^{16}$ reactions are compared using the principle of detailed balancing. On the basis of the $C^{13}(\alpha,n)$ angular distributions spin assignments for 14 states of O^{17} between excitation energies 7 and 9 MeV are discussed, and in some cases relative parity assignments are made. Reduced widths of the states of O^{17} were derived from the results of the experiments on the $C^{13}(\alpha,n)$ reaction and the oxygen total neutron cross-section. A.

539.172.4

345. CROSS SECTION FOR THE (n,2n) REACTION IN Be^9. G.J.Fischer.
Phys. Rev., Vol. 108, No. 1, 99-103 (Oct. 1, 1957).

The cross-section was measured for neutron energies between 2.6 and 3.25 MeV. It was found that the reaction sets in sharply at approximately 2.7 MeV, from which energy the cross-section rises rapidly to 0.70 barn at 3.25 MeV. This experimental result strongly suggests that the reaction proceeds primarily by means of an inelastic interaction which leaves the excited Be^9 nucleus in its 2.43 MeV level before emission of the second neutron upon breakup.

There is no peak in the (n,2n) cross-section corresponding to the broad peak at 2.73 MeV in the total neutron cross-section. A.

539.172.4

346. NUCLEAR TOTAL CROSS-SECTIONS FOR 350 MeV NEUTRONS.
A.Ashmore, R.G.Jarvis, D.S.Mather and S.K.Sen.
Proc. Phys. Soc. A, Vol. 70, Pt 10, 745-55 (Oct., 1957).

Measurements have been made of the total cross-sections of a number of elements for neutrons with a mean energy of 351.5 ± 2.0 MeV. The measured cross-sections in millibarns were:

carbon	285.3 ± 1.6	copper	1138 ± 9	hydrogen	35.6 ± 0.7
oxygen	366 ± 3	tin	1887 ± 15	deuterium	58.9 ± 1.0
aluminium	565 ± 4.5	lead	2828 ± 14	n–n	23.3 ± 0.7

A comparison with previous measurements shows that the total cross-sections of complex nuclei remain constant within the experimental error 1% between neutron energies of 270 MeV and 380 MeV. At 410 MeV they have risen significantly due to meson production. A.

539.172.4

347. THERMAL-NEUTRON FISSION CROSS SECTIONS FOR ISOTOPES OF PLUTONIUM, AMERICIUM AND CURIUM.
E.K.Hulet, R.W.Hoff, H.R.Bowman and M.C.Michel.
Phys. Rev., Vol. 107, No. 5, 1294-6 (Sept. 1, 1957).

The following thermal-neutron fission cross-sections were measured in the thermal column of the Materials Testing Reactor: Pu^{238}, 18.4 ± 0.9 barns; Am^{241}, 3.13 ± 0.15 barns; Am^{242}, 6390 ± 500 barns; Am^{243}, < 0.072 barn; Cm^{243}, 690 ± 50 barns; Cm^{245}, 1880 ± 150 barns. In addition, a pile neutron capture cross-section of 520 ± 40 barns has been measured for Pu^{238}. A.

539.172.4

348. VELOCITIES OF FRAGMENT PAIRS FROM U^{233}, U^{235}, AND Pu^{239} FISSION. W.E.Stein.
Phys. Rev., Vol. 108, No. 1, 94-8 (Oct. 1, 1957).

Velocities of the fragment pairs from thermal-neutron-induced fission of U^{233}, U^{235}, and Pu^{239} were measured by a time-of-flight method. The primary masses and energies of the fragments were determined from the conservation of mass number and momentum. These results are compared with previous fission-fragment-mass and -energy measurements. A decrease of the total kinetic energy near the symmetric mode is observed, which is in agreement with previous double-ionization-chamber measurements. The intrinsic energy spread for mass-97 fragments was found to be 8.1 ± 1.6% with a 95% confidence interval. A.

539.172.4 : 539.166

349. GAMMA-RAY DOSE AND HEATING FROM SPENT M.T.R. [MATERIALS TESTING REACTOR] FUEL ELEMENTS.
W.E.Francis and L.L.Marsden.
Nucleonics, Vol. 15, No. 4, 80-3 (April, 1957).

Dose rates from M.T.R. elements with fuel burn-ups of 3.5-35% were measured under water at distances from 1 in. to 1 ft from the element. The measurements were in good agreement with the calculated values for distances less than 3 in. from the element. R.D.Smith

539.172.4

350. CRITICAL MASSES OF ORALLOY ASSEMBLIES.
G.A.Graves and H.C.Paxton.
Nucleonics, Vol. 15, No. 6, 90-2 (June, 1957).

Experimental measurements of the critical masses of enriched uranium (93.5% U^{235}) in various configurations are summarized. The data include bare and reflected solid spheres, lattices of cubes or rods in water and plates in graphite. Some data for Pu^{239} and U^{233} is included, and it is shown that in many configurations the critical mass for these materials is 1/3 that for 93.5% U^{235}. R.D.Smith

539.172.4 : 664.8

351. FOOD-IRRADIATION REACTOR. D.T.Bray and C.F.Leyse.
Nucleonics, Vol. 15, No. 7, 76-9 (July, 1957).

A design study using a M.T.R. (Materials Testing Reactor) core and a light-water solution of indium sulphate as a blanket. The normal operating power is 10.5 MW and the indium sulphate is piped to external irradiators having an output of 3 megarep ton/hr. The alternative schemes of the direct use of core γ-radiation, or irradiation by circulated fuel or gaseous fission products are unsuitable owing to excessive neutron irradiation or low efficiency. Other blanket materials including scandium, lanthanum, manganese and sodium may be useful for larger systems. R.D Smith

539.172.4 : 664.8

352. REACTOR-IRRADIATOR FOR MEAT.
E.O.Guernsey and R.M.Ball.
Nucleonics, Vol. 15, No. 7, 80 (July, 1957).

A design study using a low-temperature reactor and a solution of indium sulphate as a blanket. The blanket is circulated to an external irradiator. R.D.Smith

ATOMS

539.18

353. δ^2 TEST FOR ATOMIC WAVE FUNCTIONS, APPLIED ON H.
H.Preuss and E.Trefftz.
Phys. Rev., Vol. 107, No. 5, 1282 (Sept. 1, 1957).

In searching for an extremum principle for wave-functions, which meets the needs of oscillator strength calculations better than the energy minimum principle, one thinks of $\delta^2 = \int[(H - E)\psi]^2 d\tau =$ = min. However, according to an estimate of James and Coolidge this should not give good results. An example, the ground state of H, is calculated with a simple approximation function, and demonstrates the truth of this assumption. It suggests that the best oscillator strengths are still achieved by (E = min) wave-functions with the dipole velocity formula. A.

539.18

354. OPEN CONFIGURATION CALCULATIONS FOR LITHIUM.
G.H.Brigman and F.A.Matsen.
J. chem. Phys., Vol. 27, No. 3, 829-30 (Sept., 1957).

The energy of the $^2S_{1/2}$ state of lithium is tabulated for eight different open configuration functions using Slater orbitals. G.I.W.Llewelyn

539.18

355. THE g_J-FACTOR OF XENON IN THE METASTABLE $^3P_2$-STATE. H.Friedburg and H.Kuiper.
Naturwissenschaften, Vol. 44, No. 18, 487 (1957). In German.

This is found to be $g_J(X) = 1.5009 \pm 0.0001$ by the atomic beam resonance method. G.E.Brown

539.18

356. HYPERFINE STRUCTURE OF K^{39} IN THE 4P STATE.
P.Buck and I.I.Rabi.
Phys. Rev., Vol. 107, No. 5, 1291-4 (Sept. 1, 1957).

The atomic-beam magnetic resonance method was used. The apparatus and method of observation were similar to those used in previous experiments on sodium, rubidium, and caesium. For K^{39}, the magnetic-dipole interaction constant in the $4P_{1/2}$ state is $a_{1/2} = 28.85 \pm 0.3$ Mc/s, the electric-quadrupole interaction constant in the $4P_{3/2}$ state is $b = 2.8 \pm 0.8$ Mc/s, and the quadrupole moment is $(0.07 \pm 0.02) \times 10^{-24}$ cm^2. A.

539.18

357. SCATTERING CROSS SECTIONS AND INTERACTION ENERGIES OF LOW-VELOCITY He^+ IONS IN HELIUM.
E.A.Mason and J.T.Vanderslice.
Phys. Rev., Vol. 108, No. 2, 293-4 (Oct. 15, 1957).

It is pointed out that the determination of ion–molecule forces from results of measurements of scattering of low-velocity ion beams in gases can be seriously in error unless some a priori knowledge of the nature of the forces is available. The scattering of He^+ in He is chosen as an illustration. The elastic and charge exchange cross-sections calculated from Moiseiwitsch's theoretical force laws (Abstr. 1486/1057) are shown to be in good agreement with the experimental values of Cramer and Simons (Abstr. 7994/1957). The force law determined by the latter authors directly from their measurements is in error because of the assumption of an incorrect form and the failure to consider the two interaction states involved. A.

539.18 : 539.12

358. THE USE OF EXTRAPOLATED QUANTUM DEFECTS AS A CHECK ON CALCULATED PHASES FOR SCATTERING OF ELECTRONS BY POSITIVE IONS. M.J.Seaton.
Proc. Phys. Soc. A, Vol. 70, Pt 8, 620-1 (Aug., 1957).

It is shown that for low energies ($k^2 \ll 2\pi Z^2$) the phase $\delta_l(k^2)$ may be approximated by $\pi\mu_l(k^2)$, where $\mu_l(k^2)$ is the quantum defect. The approximation is shown to be in accord with Hartree–Fock calculations for Na 6^2pk^2p. It is also shown for He that for $k \leq 1.831$ the quantum defect may be expressed as a linear function of energy. R.W.Nicholls

539.18

359. SLOW COLLISIONS BETWEEN HEAVY PARTICLES.
D. R. Bates.
Proc. Roy. Soc. A, Vol. 243, 15-23 (Dec. 10, 1957).

Certain coupling terms neglected in the perturbed stationary state and related approximations for treating slow collisions between heavy particles are discussed. It is pointed out that their inclusion would make the group of approximations in question tend to the Born approximation at high impact energies and weak interactions. One member of the group differs from the Born approximation only in the coupling terms. Information on the importance of these terms can hence be obtained by comparing the values of cross-sections given by this member with the corresponding values given by the Born approximation. Calculations are carried out on the processes

$$H^+ + H(1s) \rightarrow H^+ + H(2p) \text{ and } H(1s) + H(1s) \rightarrow H(1s) + H(2p).$$

A.

539.18

360. ATOMIC MASSES OF H^1, C^{12}, AND S^{32}.
K.S.Quisenberry, C.F.Giese and J.L.Benson.
Phys. Rev., Vol. 107, No. 6, 1664-7 (Sept. 15, 1957).

A 16 in. double-focusing mass spectrometer was used to measure a series of mass doublets which enable one to calculate the atomic masses of H^1, C^{12}, and S^{32}. The doublet $\frac{1}{2}C_4H_4O\text{-}H_2O_2$ is used to relate the C^{12} mass directly to that of the O^{16} standard. Tests of the instrument and its calibration give confidence in the reliability of the results. The resulting mass values are $H^1 = 1.008\,1452 \pm 2$, $C^{12} = 12.003\,8156 \pm 4$, and $S^{32} = 31.982\,2388 \pm 9$ a.m.u. These values differ from the previously reported results by more than the published errors might lead one to predict. However, in no cases do the changes reflect a significant change in previously published atomic masses. A.

539.18

361. THE INFLUENCE OF ADSORPTION AND OF SURFACE MIGRATION ON THE ISOTOPIC SEPARATION IN A GAS DIFFUSING THROUGH A POROUS PARTITION.
P.Caldirola and G.Rossi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1374-6 (May, 1957).
In Italian.

Qualitative agreement is obtained between the calculations of the authors and the experimental results of Trawick and Berman (Abstr. 5578/1957) for the diffusion of O_2, N_2 and A through a high surface area silica powder pack. H.C.Cole

539.18

362. COLLISIONAL DE-EXCITATION OF μ-MESONIC ATOMS.
T.B.Day and P.Morrison.
Phys. Rev., Vol. 107, No. 3, 912-13 (Aug. 1, 1957).

The experimental results of Stearns and Stearns (Abstr. 4637/1957) are explained in terms of Auger scattering and Auger exchange, which for the 2p–1s transition in Li proceeds 100 times faster than the normal Auger process. It is inferred that the saturation effect in the nuclear catalysis of the p–d reaction in liquid H_2 depends on exchange collisions between μ–proton atoms and deuterons.

E.J.Burge

539.18

363. MESONIC ATOMS: RADIATIVE YIELDS OF THE π-MESON L SERIES. M.B.Stearns, M.Stearns and L.Leipuner.
Phys. Rev., Vol. 108, No. 2, 445-9 (Oct. 15, 1957).

The total radiative yields of the L series from π-mesonic atoms were measured for most of the elements from B through As. The yield curve has a broad maximum of $\sim 70\%$ in the region $12 \leq Z \leq 16$ and decreases at both higher and lower Z values. This decrease is presumably due to competition from direct nuclear absorption at the higher Z's and to nonradiative processes at the lower Z's. The yields are fairly constant for $25 \leq Z \leq 30$, suggesting a possible magic number effect at Z = 28. The rapid decrease in yield with decreasing Z cannot be attributed to competition between the simple Auger effect and radiative transitions. The simple Auger transitions probabilities are about 40 times smaller than the observed values. More complex nonradiative processes are probably involved, such as those proposed by Day and Morrison. A.

539.185.08 : 539.1.07

NEUTRON SPARK COUNTER. See Abstr. 253-4

MOLECULES

539.19 : 534.22

CALCULATION OF VIBRATIONAL RELAXATION TIMES IN GASEOUS SO_2. See Abstr. 90

539.19 : 533.7

364. POTENTIAL PARAMETERS FOR KRYPTON. M.P.Madan.
J. chem. Phys., Vol. 27, No. 1, 113-15 (July, 1957).

Thermal diffusion in krypton is used in conjunction with thermal conductivity to obtain the intermolecular force parameters of modified Buckingham Exp:6 potential energy function. Experimental data are reduced and smoothed by using a method described in a previous paper. The accuracy of force parameters are tested by calculating values of the coefficient of self-diffusion and viscosity at different temperatures and comparing the results with experimental data. Satisfactory agreement is found. A.

539.19

365. INELASTIC MOLECULAR COLLISIONS WITH A MAXWELLIAN INTERACTION ENERGY. B.Widom.
J. chem. Phys., Vol. 27, No. 4, 940-52 (Oct., 1957).

The radial Schrödinger equation for arbitrary values of the angular momentum is solved exactly with a repulsive R^{-4} potential energy, the solutions being Mathieu functions whose arguments are linear functions of logR. These solutions are then applied to the problem of vibrational relaxation in the distorted wave approximation. Emphasis is given to the case in which the energy which is exchanged in the inelastic collision, ϵ_0, is very much greater than the smaller of the energies of the incident and emergent waves. It is found that in this case the energy exchange probability per collision is proportional to a sinusoidal factor which may have a value anywhere between 0 and 1, depending on the precise magnitude of ϵ_0; to a factor which decreases as the exponential of $\epsilon_0^{1/4}$; and to a factor which depends on the angular momentum quantum number, l, and on the smaller of the incident and emergent wave numbers, k. This last factor is evaluated for fixed l with k^{-1} much less than the effective range of molecular interaction; for fixed l with k^{-1} much greater than the effective range; and for l large with k fixed. The relaxation time is obtained and both its magnitude and temperature dependence are discussed. Over an appropriate range of temperature it is found to decrease as the exponential of $-T^{1/3}$, which is not the same as the Landau–Teller exponential of $T^{-1/3}$. The temperature dependence found is in much better agreement with the observed high-temperature vibrational relaxation of oxygen, and still better agreement is obtained when the present approximation methods are applied with an exponential interaction energy. The magnitude of the relaxation time, however, is not predicted nearly so well as is its temperature dependence. A.

539.19

366. LAW OF MOLECULAR INTERACTION FOR KRYPTON.
M.P.Madan.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1369-70 (May, 1957).

The force parameters for krypton were evaluated by a thermal diffusion method and are used to calculate the viscosity of krypton at a number of temperatures. Good agreement is obtained with observed viscosity values. H.C.Cole

539.19

367. RESTORING FIELD AND DISPLACEMENT OF THE VIBRATION FREQUENCY OF A POLAR MOLECULE IN A POLAR ENVIRONMENT. L.Galatry and F.G.Schuller.
C.R. Acad. Sci. (Paris), Vol. 245, No. 9, 901-3 (Aug. 26, 1957).
In French.

A generalization of a previous calculation for the case where the molecules of the solvent have a permanent dipole. The method is applied to the HCl molecule. R.C.Seymour

539.19

368. VIBRATIONAL INTENSITIES. VIII. CH_3 AND CD_3 CHLORIDE, BROMIDE, AND IODIDE.
A.D.Dickson, I.M.Mills and B.Crawford, Jr.
J. chem. Phys., Vol. 27, No. 2, 445-55 (Aug., 1957).

For Pt VII see Abstr. 5507 (1957). Absolute intensity measurements were made on the fundamental vibrations of methyl chloride, bromide, and iodide, and their fully deuterated derivatives, by integrating the optical density over the absorption bands. The bands were fully pressure broadened by using up to 80 atm of foreign gas. Band separations were made graphically. The results are analysed in terms of the dipole moment derivatives with respect to symmetry coordinates in the molecule, $(\partial p/\partial S_j)$. The data on the different

isotopic species are shown to yield consistent results, and this requirement of consistency was also used as an aid in the analysis. In the E-class vibrations the signs of the dipole moment derivatives were determined unambiguously by assuming the permanent dipole to be directed CH_3^+–X^-. A.

539.19

369. HIGHER ORDER ROTATION-VIBRATION ENERGIES OF POLYATOMIC MOLECULES. II.
G.Amat, M.Goldsmith and H.H.Nielsen.
J. chem. Phys., Vol. 27, No. 4, 838-44 (Oct., 1957).

For Pt I see Abstr. 6050 (1956). The calculations of third- and fourth-order rotation-vibration energies of a general polyatomic molecule are continued with a discussion of the zero-, first-, second-, and third-order transformed Hamiltonians. A.

539.19

370. HIGHER ORDER ROTATION-VIBRATION ENERGIES OF POLYATOMIC MOLECULES. III. G.Amat and H.H.Nielsen.
J. chem. Phys., Vol. 27, No. 4, 845-50 (Oct., 1957).

The Hamiltonian derived in Pt II (see preceding abstract) is further transformed to facilitate calculation. A.

539.19

371. VIBRATIONAL INTENSITIES IN HALOGENATED METHANES. III. THE INTERPRETATION OF SOLUTION DATA.
W.C.Mallard and J.W.Straley.
J. chem. Phys., Vol. 27, No. 4, 877-9 (Oct., 1957).

For Pt II see Abstr. 2515 (1957). Using solution samples, the absolute infrared absorption intensities of five fundamental bands of CH_2Cl_2 were measured by an extrapolation technique and by approximate methods suggested by Ramsay. These determinations were used to test a classical relationship, proposed by Polo and Wilson, between corresponding liquid and vapour absorption band intensities. Qualitative agreement with published vapour intensity measurements was obtained. A.

539.19

372. A DIRECT METHOD FOR THE DETERMINATION OF THE IRREDUCIBLE REPRESENTATIONS ASSOCIATED WITH HARMONICS AND COMBINATIONS OF MOLECULAR VIBRATIONS.
C.Duculot.
Mem. Acad. Roy. Belgique Cl. Sci. (Coll. in 8vo), Vol. 30, 90 pp. (1957). In French.

A method for obtaining the nature and multiplicity of the irreducible representations of an excited vibration state (overtone or combination-tone) is presented in detail. It is a development of group theory and avoids the classical method of calculation. G.Allen

539.19

373. ELECTRONIC SPECTRA OF CARBONIUM IONS.
A.A.V.Stuart and E.L.Mackor.
J. chem. Phys., Vol. 27, No. 3, 826-7 (Sept., 1957).

The experimental absorption spectra of four aromatic carbonium ions obtained in HF solutions are compared with the bands calculated using the self-consistent field method. The semi-quantitative agreement obtained indicates that this approach is roughly applicable to these ionic systems. G.I.W.Llewelyn

539.19

374. ELECTRONIC ABSORPTION SPECTRA OF HETEROCYCLIC SYSTEMS. II. APPLICATIONS TO SOME TWO-RING NITROGEN HETEROCYCLICS. T.E.Peacock.
Proc. Phys. Soc. A, Vol. 70, Pt 9, 654-60 (Sept., 1957).

The methods of Pt I (Abstr. 8759/1957) are applied in a theoretical analysis of the spectra of nitrogen derivatives of naphthalene and stilbene. The results provide, in every case, a satisfactory account of the main absorption bands and of the effects of nitrogen substitution. A simplified method, which permits very rapid estimates of shifts due to substitution in terms of data for the parent hydrocarbon, is found to be satisfactory and should be of general value. A.

539.19

375. A NEW METHOD OF CALCULATING THE ELECTRONIC TERMS OF MOLECULES. W.Bingel.
Z. Naturforsch., Vol. 12a, No. 1, 59-70 (Jan., 1957). In German.

A new approximation is developed which is based on exact eigenfunctions of the "united atom". The computed molecular terms become, for zero internuclear distance, those of the united atom. It is also shown how the molecular transition moments and dipole moments can be determined in this theory as functions of internuclear distances. J.Jacobs

539.19

376. THE APPEARANCE OF ADDITIONAL ABSORPTION PEAKS IN ELECTRON RESONANCE UNDER SATURATION CONDITIONS. N.S.Garif'yanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 609 (1957). In Russian.

When modulation fields of high intensity, and of frequency great than the line-width, are applied in nuclear or electron resonance, extra peaks appear, which are separated from the principal lines by the modulation frequency. This effect is demonstrated for electron resonance of diphenyl picryl hydrazyl at 30 Mc/s by inclining the high-frequency field H_ν to have a component along the static field H_0. With H_ν = 2 Oe inclined at 45° to H_0 the extra peaks are half as intense as the main lines and the latter disappear when the angle is reduced to 0°. D.H.Whiffen

539.19 : 621.317.36

377. A FREQUENCY COMPARATOR USING ELECTRON AND PROTON RESONANCE IN A COMMON MAGNETIC FIELD.
O.Nourse.
Nature (London), Vol. 180, 192 (July 27, 1957).

Electron spin resonance in the free radical diphenyl trinitrophenyl hydrazyl is observed at the unknown microwave frequency simultaneously with proton resonance at a known radiofrequency. The microwave frequency is then equal to the radiofrequency multiplied by the ratio of the gyromagnetic ratios of electron and proton (≃ 658.5). The accuracy of the method, which is stated to be 0.8 Mc/s in 35 000 Mc/s, is limited by the free-radical line width and by the lack of homogeneity or stability of the magnetic field. Other materials may lead to greater accuracy. D.J.Olive

539.1

378. TUNNELING THROUGH HIGH PERIODIC BARRIERS. II. APPLICATION TO NUCLEAR MAGNETIC RESONANCE IN SOLIDS. T.P.Das.
J. chem. Phys., Vol. 27, No. 3, 763-81 (Sept., 1957).

Analytic formulae derived in Pt I (Abstr. 2475/1957) for the frequency of tunnelling through high periodic barriers are used to derive from nuclear magnetic resonance data in solids the heights of the potential barriers hindering the rotational motion of molecule The rotations of CH_3 groups, NH_3^+ groups, benzene, NH_2 groups and water molecules of crystallization are considered. The use of the barrier heights in correcting for the effect of torsional vibrations o molecules on molecular dimensions obtained from nuclear magnetic resonance data is illustrated. A possible explanation of an isotropi part of the splitting of the proton resonance in $Li_2SO_4 \cdot H_2O$, reported earlier by Pake, is presented. Comments are made on the relative magnitudes of the barrier heights in the different molecules considered. A

539.19

379. A VARIATIONAL METHOD FOR CALCULATING MAGNETIC SHIELDING CONSTANTS IN MOLECULES. M.J.Stephen.
Proc. Roy. Soc. A, Vol. 243, 264-73 (Dec. 24, 1957).

The general variational method is applied to the problem of calculating magnetic shielding constants in molecules. Using approximate variation functions together with simple molecular-orbital and valence-bond wave-functions calculations have been made for the molecules of hydrogen, methane, ethylene and acetylene. An approximation using the calculated diamagnetic susceptibility is used for electrons which are not localized near the magnetic nucleus considered. The results are in good agreement with experiment and in particular it is shown that the shielding constant for acetylene should lie between those for methane and ethylene. A

539.1

380. VARIATIONAL CALCULATION OF THE NUCLEAR MAGNETIC SHIELDING OF THE PROTON. B.R.McGarvey.
J. chem. Phys., Vol. 27, No. 1, 68-74 (July, 1957).

A variational method employing the unperturbed ground state wave-function for the molecule is used to calculate the shielding of the proton in the hydrogen and hydrogen halide molecules. Surprisingly good results are obtained in view of the approximations employed in the calculation. The computations show that the shielding depends on the ionic character of the bond, the bond distance, and the number of electrons on the atom to which the hydrogen is bonded. A

539.1

381. A VARIATIONAL METHOD FOR CALCULATING NUCLEAR SPIN–SPIN INTERACTIONS IN MOLECULES.
M.J.Stephen.
Proc. Roy. Soc. A, Vol. 243, 274-80 (Dec. 24, 1957).

A general variation method is developed for determining:

(a) the magnetic shielding of nuclear spin–spin interactions in molecules; (b) the electron-coupled nuclear spin–spin interactions in molecules. Using simple valence-bond and molecular-orbital wave-functions calculations have been made for the HD molecule. It is concluded that effect (a) is small compared with (b). Both wave-functions lead to values for the zero magnetic field splitting of about 49 c/s, in good agreement with the observed value of 43 c/s. A.

539.19

382. USE OF POLAR COORDINATES FOR MOLECULAR WAVE FUNCTIONS. G.S.Handler and J.R.Arnold.
J. chem. Phys., Vol. 27, No. 1, 144-6 (July, 1957).

Since integrations in polar coordinates are extremely simple, and since the resulting expressions can be extensively tabulated in terms of known functions, it was felt that one might be able to find accurate wave functions for simple molecules using a variational procedure and offsetting the poor initial behaviour with a large number of terms. The cases studied are H_2, H_3^+ linear, and H_3^+ triangular. Convergence is found to be extremely poor, and it is estimated that of the order of fifty terms would be necessary to secure an acceptable result. A.

539.19

383. SIMPLE MOLECULAR ORBITAL THEORY OF CONJUGATION IN VINYL BROMIDE AND BROMOBENZENE. J.A.Howe and J.H.Goldstein.
J. chem. Phys., Vol. 27, No. 4, 831-4 (Oct., 1957).

Quadrupole coupling constants for vinyl bromide, supplemented by other data of spectroscopic origin, are utilized to obtain a value for the resonance integral, β_{CBr}, in simple molecular orbital theory with inclusion of overlap. Using this parameter, resonance dipole moments were calculated for vinyl bromide and bromobenzene, in reasonable agreement with experiment. Assumptions and approximations involved in the method are reviewed, and the properties of carbon–halogen bonds are discussed in the light of the results of this and similar previous studies. A.

539.19

384. SOME OVERLAP INTEGRALS INVOLVING d ORBITALS. II. J.L.Roberts and H.H.Jaffé.
J. chem. Phys., Vol. 27, No. 4, 883-8 (Oct., 1957).

For previous work see Abstr. 2599 (1953). Overlap integrals between 3dσ orbitals, between 5dσ orbitals, and between 3dσ and 5dσ orbitals were computed using an I.B.M. 650 MDDPM. The programme is briefly discussed. Analytic relations between dσ–dσ coaxial and symbactic overlap integrals are derived. A

539.19 : 537.226.1

385. INDUCED POLARIZATION AND DIELECTRIC CONSTANT OF POLAR LIQUIDS. R.H.Cole.
J. chem. Phys., Vol. 27, No. 1, 33-5 (July, 1957).

The role of induced polarization in statistical theory of the dielectric constant of polar molecules is examined using the classical harmonic oscillator model of induced displacements by external and intermolecular fields. In the absence of translational fluctuations and anisotropy of polarizability, the theory leads to the results of Kirkwood and Onsager. Reasons for different results obtained by other developments are discussed. A.

539.19 : 535.343

386. VIBRATIONAL SPECTRA AND STRUCTURE OF PHOSPHONIUM AND DEUTERO-PHOSPHONIUM IODIDES. J.V.Martinez and E.L.Wagner.
J. chem. Phys., Vol. 27, No. 5, 1110-13 (Nov., 1957).

The infrared spectra of sublimed films of PH_4I and PD_4I were obtained at −78° and −190°C in the region 4000-400 cm^{-1}. Powder and Nujol mull spectra were obtained at room temperature. The low temperature spectra could be interpreted on the basis of V_d site symmetry for the PH_4^+ ions as occurs in the phase III NH_4Br and NH_4I structures. The room temperature spectra are also compatible with the room temperature X-ray structure, D_{4h}^7. No evidence for any sort of transition was found. The hydrogen bond energy in PH_4I is less than 0.5 kcal/mole. A.

539.19

387. EVALUATION OF MOLECULAR QUADRUPOLE MOMENTS FROM MICROWAVE LINE BREADTHS. II. EXPERIMENTAL. H.Feeny, W.Madigosky and B.Winters.
J. chem. Phys., Vol. 27, No. 4, 898-900 (Oct., 1957).

For Pt I see Abstr. 8913 (1956). An improved microwave spectroscope was used to determine the effect of O_2, N_2, CO_2, and H_2 in broadening the $J = 3 \rightarrow 3$ inversion line of ammonia. An accurate evaluation of the molecular quadrupole moments of these gases was obtained from the measured collision diameters of 4.32, 5.64, 7.45, and 3.28 A units, respectively. A.

539.19 : 535.343

STRUCTURE, DIPOLE MOMENT, AND QUADRUPOLE COUPLING CONSTANTS OF FORMAMIDE. See Abstr. 126

539.19

388. ESTIMATES OF HAMMETT'S SIGMA VALUES FROM QUADRUPOLE RESONANCE STUDIES. P.J.Bray and R.G.Barnes.
J. chem. Phys., Vol. 27, No. 2, 551-60 (Aug., 1957).

A linear correlation exists between the Cl^{35} pure quadrupole resonance frequency in substituted chlorobenzenes and the Hammett parameter sigma for the substituent. The relation is expressed as $f = 1.024\sigma + 34.826$ Mc/s. For the 52 frequencies used in determining this relation, the correlation coefficient is $r = 0.96$ and the root-mean-square deviation of the experimentally determined f values from those predicted by the equation is 360 kc/s. A proper ortho sigma parameter for use in the f v. σ correlation is apparently the value derived from the Hammett relation $\sigma = \ln K/K_0$ in which K and K_0 are the equilibrium constants for ionization of the substituted and unsubstituted benzoic acid in water at 25°C. This parameter is linearly proportional to the polar substituent σ* of Taft for the ortho substituent. In the many multiply substituted chlorobenzenes investigated, the proper total sigma value has been taken as the sum of the individual parameters. Few cases are apparent in which the linear relation of f to σ is seriously violated. Additivity of the electron displacement properties of substitution, suggested by Jaffe and indicated by studies of the magnetic shielding in fluorobenzenes, is apparently confirmed. Sigma values for 29 substituents are estimated from the Cl^{35} pure quadrupole resonance frequency measured in the substituted chlorobenzene. A.

SOLID-STATE PHYSICS

539.2 : 536.71

389. TEMPERATURE-DEPENDENT EQUATIONS OF STATE OF SOLIDS. J.J.Gilvarry.
J. appl. Phys., Vol. 28, No. 11, 1253-61 (Nov., 1957).

An isothermal equation of state of a solid is considered, which contains as special cases the equations of Birch, Murnaghan, Bardeen, and others. The equation is generalized to arbitrary temperature by replacing two constants of the equation by temperature-dependent parameters, whose functional form is determined by considerations of thermodynamic consistency. The thermal properties of the solid implied by this equation of state are examined. It is shown that the generalized equation is consistent with the Mie–Grüneisen relation for the thermal pressure of the lattice, and that the corresponding Grüneisen parameter is only slightly dependent on temperature, in general. The form of the generalized equation of state at low temperature is exhibited as an explicit function of volume and temperature for a solid whose heat capacity obeys the Debye law. A comparison with pressure–volume data of Swenson for potassium at low temperatures shows excellent agreement of the generalized equation of state with experiment. A.

539.2

390. LATTICE ENERGY OF CRYSTALLINE POLYETHYLENE. F.W.Billmeyer, Jr.
J. appl. Phys., Vol. 28, No. 10, 1114-18 (Oct., 1957).

The heat of sublimation of linear paraffin chains from the crystalline form to the gas at 0°K is calculated from heats of fusion, heats of vaporization, and heat capacities of solid, liquid, and gaseous hydrocarbons. The heat of sublimation, which is defined as the lattice energy of the crystalline phase of linear polyethylene, is 1.84 kcal/mole of CH_2 groups. The heat of fusion of crystalline linear polyethylene is 0.922 kcal/mole of CH_2 groups. A.

539.2

391. DEFINITION OF ENERGY BANDS IN THE PRESENCE OF AN EXTERNAL FORCE FIELD. E.N.Adams.
Phys. Rev., Vol. 107, No. 3, 698-701 (Aug. 1, 1957).

It is shown that for an electron moving in a periodic potential perturbed by a weak electric field the "physical energy bands" differ from the energy bands in the absence of the perturbing field. By means of a wave-packet treatment it is shown that for very weak fields the modified bands are those suggested earlier by Wannier (Abstr. 2269/1956) and by Adams and Argyres (Abstr. 5144/1956).

In stronger fields, no such treatment can be given, and the functions defined by Wannier for that case do not represent "physical energy bands" in the same sense. A.

539.2

392. ELECTRON ENERGY BANDS IN CESIUM.
J.Callaway and E.L.Haase.
Phys. Rev., Vol. 108, No. 2, 217-21 (Oct. 15, 1957).

The orthogonalized plane wave method and the cellular method are applied to a calculation of electronic energy levels in caesium. The same crystal potential was used for all states. Wave-functions of core electrons, required in the application of the orthogonalized plane wave method, were determined for this potential. The cohesive energy was calculated according to a simple model. The magnitude at a nucleus of the wave-function of an electron on the Fermi surface was estimated by perturbation theory. The energies of 24 states at four symmetry points of the Brillouin zone are obtained. The bands inferred from these results are compared with those in other alkali metals. A.

539.2

393. THE SPLITTINGS INDUCED IN LEVELS BY CRYSTAL FIELDS OF HIGH SYMMETRY. B.R.Judd.
Proc. Phys. Soc. B, Vol. 70, Pt 9, 880-3 (Sept., 1957).

The matrix elements of the crystalline field may be calculated in cases of high symmetry by the application of group theory and the fact that the sum of the roots of the secular determinantal equation equals the sum of the diagonal elements; it is then unnecessary to solve that equation explicitly. E.P.Wohlfarth

539.2 : 537.312

394. CYCLOTRON RESONANCE IN TIN.
A.F.Kip, D.N.Langenberg, B.Rosenblum and G.Wagoner.
Phys. Rev., Vol. 108, No. 2, 494-5 (Oct. 15, 1957).

Describes observation of the Azbel–Kaner type of cyclotron resonance in single crystals of tin at 24 kMc/s and 4°K, in fields up to 6 kG. Plots of dR/dH against H (where R is the surface resistance) show the expected oscillatory pattern, with peaks at $H = H_C/n$; for a typical curve, $H_C = 25$ kG, and the observed peaks run from $n = 5$ to $n = 13$. As expected, H_C varies linearly with frequency (over a 10% range). For different orientations, the observed effective masses $m^* = eH_C/\omega c$ range from 0.2 to 3 electron masses. Strong oscillations are sometimes found even when the field H is inclined at 30° to the specimen surface. A large variation in dR/dH is also observed at low fields (< 1 kG); possible reasons for this are discussed. R.G.Chambers

539.2 : 537.311.33

395. INTERACTION BETWEEN ELECTRONS AND LATTICE VIBRATIONS. J.Bardeen.
Canad. J. Phys., Vol. 34, No. 12A, 1171-89 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). A review. The various methods of calculating electron–phonon interaction in monovalent metals are critically discussed. The dominating influence of umklapp processes on transport properties at low temperatures is emphasized. Deformation potential methods in semiconductors and the polaron problem are also briefly discussed. 42 references. D.M.Edwards

539.2 : 548.7

396. ELECTRON–PHONON EQUILIBRIUM AND THE TRANSPORT PHENOMENA IN METALS AT LOW TEMPERATURES.
E.H.Sondheimer.
Canad. J. Phys., Vol. 34, No. 12A, 1246-55 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). Considers the influence of lattice non-equilibrium upon transport phenomena in the absence of magnetic fields. D.M.Edwards

539.2

397. THE GENERAL VARIATIONAL PRINCIPLE OF TRANSPORT THEORY. J.M.Ziman.
Canad. J. Phys., Vol. 34, No. 12A, 1256-73 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). The variational principle for the Boltzmann equation is shown to be a special case of the general theorem of maximum entropy production in irreversible thermodynamics. Calculation of entropy production thus leads directly to variational principles for Boltzmann equations of any degree of complexity. The determination of transport coefficients is facilitated and in particular a simple formula for the lattice thermal conductivity is obtained. The principle is generalized to phenomena in a magnetic field by modifying the formula for entropy production in the non-equilibrium state. D.M.Edwards

539.2

398. ELECTRON INTERACTION IN SOLIDS. D.Pines.
Canad. J. Phys., Vol. 34, No. 12A, 1379-94 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). Describes recent work by Nozières and Pines. It is concluded that for most metals electron–electron interaction is of the screened Coulomb type as in the free electron case. Calculations of its influence on electron transport are reviewed. A preliminary discussion is given of electron interaction in solids where there are two distinct groups of electrons. It is proposed that there may be an independent mode of elementary excitation of the "two-plasma" system, and such excitations are named acoustic plasmons or demons. D.M.Edwards

539.2

399. CORRELATION ENERGY OF AN ELECTRON GAS AT HIGH DENSITY: PLASMA OSCILLATIONS.
K.Sawada, K.A.Brueckner, N.Fukuda and R.Brout.
Phys. Rev., Vol. 108, No. 3, 507-14 (Nov. 1, 1957).

The contribution from zero-point plasma oscillations to the correlation energy of an electron gas at high density is considered, using the exact high-density theory of Gell–Mann and Brueckner (Abstr. 6372/1957) and of Sawada (Abstr. 6374/1957). The plasmon energy is determined as a function of q by an eigenvalue equation identical with the dispersion relation of Bohm and Pines. The plasma solutions are stable only below the energy-momentum values at which they merge with the continuum spectrum arising from particle excitation, thus introducing a natural cutoff into the theory. At high density, however, it is shown that this cutoff can be allowed to become infinite without affecting the correlation energy. The contribution from the plasma energy is exactly re-expressed in terms of the contribution from the scattering states by making use of the analytic properties of the scattering amplitudes. This transformation also establishes the connection between the Gell–Mann–Brueckner and Sawada results. Some remarks are finally made on the relation between these results and those of Bohm and Pines (Abstr. 1278/1954, 6038/1956). A.

539.2

400. CORRELATION ENERGY OF A HIGH-DENSITY GAS: PLASMA COORDINATES. R.Brout.
Phys. Rev., Vol. 108, No. 3, 515-17 (Nov. 1, 1957).

The model Hamiltonian of Sawada which describes electron correlation at high density is examined. It is shown that the set of scattering modes for momentum transfers below a certain q_{max} is not complete. It is completed by the plasma mode. $(q_{max})^{-1}$ is the natural Debye length of the theory. A.

539.2

401. CREATION OF DISLOCATIONS IN LiF AT LOW STRESSES.
J.Weertman.
J. appl. Phys., Vol. 28, No. 9, 1068-9 (Sept., 1957).

Dislocation sources can be formed by the precipitation of vacancies (Abstr. 2246/1952). It is proposed that such sources were operative in the experiments of Gilman and Johnston (Abstr. 9037/1956). A.B.Lidiard

539.2

402. DISLOCATION ARRAYS IN GERMANIUM.
W.W.Tyler and W.C.Dash.
J. appl. Phys., Vol. 28, No. 11, 1221-4 (Nov., 1957).

Dislocation arrays were observed in deformed germanium using a technique based on the selective etching of lithium precipitates which prefer to nucleate on or near dislocations. Evidence is presented which indicates that both internal Frank–Read sources and surface dislocation sources are of importance in the deformation of germanium. A.

539.2

403. DISLOCATIONS IN WHISKERS.
W.W.Webb, R.D.Dragsdorf and W.D.Forgeng.
Phys. Rev., Vol. 108, No. 2, 498-9 (Oct. 15, 1957).

An improved X-ray technique has been devised to study the theoretically predicted twisting of the crystal lattice of a whisker about the whisker axis. Whiskers of Zn, Cu, Fe, Ni, Mn, Ag and Pd grown by chemical reaction most commonly showed no lattice twist. Sapphire (α-Al_2O_3) whiskers were found to be twisted by amounts corresponding to a single axial screw dislocation. Some whiskers of Ag, Pd and Cu grew as helices and twisted prisms, effects which can be interpreted in terms of climb of the dislocation at the tip of the growing whisker. A.B.Lidiard

539.2

404. APPROXIMATE WAVE FUNCTIONS FOR THE M-CENTER BY THE POINT-ION LATTICE METHOD.
B.S.Gourary and P.J.Luke.
Phys. Rev., Vol. 107, No. 4, 960-5 (Aug. 15, 1957).

Qualitative arguments are presented, suggesting that the point-ion lattice model, first used by Gourary and Adrian for the F-centre, should be generalized to all those states of electron-excess colour centres in the alkali halide crystals which give rise to transitions, obeying the Ivey relations. The point-ion lattice model is then postulated for Seitz's model of the M-centre, and two sets of transition energies are obtained for a whole series of alkali halides. The A_1B_1 transition agrees with the M-band within some 15%. Its dipole matrix element has the [110] direction. The A_1B_2 transition lies at a shorter wavelength. In LiF and NaF it is close to the F-band. Its dipole matrix element has the [100] direction. Oscillator strengths are also given. There is some possibility, however, that the B_2 state may not be bound. The contact term in the hyperfine structure is estimated for LiF and LiI, using an alternate form of wave-function. Experiments are suggested to verify the Ivey relations and the other predictions of the point-ion lattice model in suitably chosen sets of alkali halide crystals, which have almost identical interionic distances. A.

539.2

405. NUCLEAR MAGNETIC RESONANCE, RADIATION DAMAGE, AND RIGIDITY IN BRANCHED POLYETHYLENE AS A FUNCTION OF TEMPERATURE. N.Fuschillo and J.A.Sauer.
J. appl. Phys., Vol. 28, No. 10, 1073-81 (Oct., 1957).

Molecular motions and microstructure were studied as a function of irradiation damage and temperature in branched polyethylene. The methods of proton magnetic resonance, specific volume and density per cent crystallinity, mechanical rigidity and loss, and X-ray-determined crystallinities were employed. The samples were subjected to irradiation doses ranging from 0 to 8.3×10^{18} nvt in the Brookhaven reactor. Significant changes in the proton resonance lines shape at 295°K occur for an irradiation of 0.3×10^{18} nvt. Second moments and intensity ratios indicate that the first effect of irradiation on the line shape can be interpreted as due to the destruction of crystallinity or order. This effect however is offset at higher doses by the restrictive influence of radiation-induced crosslinks on molecular chain motion. Estimates of the per cent crosslinking aid in the interpretation of the temperature variation of proton resonance line shapes and allow some estimate to be made of the lengths of chain associated with a given type of molecular motion. Activation energies are calculated from N.M.R. and mechanical loss data for these molecular motions. With increasing temperature the proton resonance and mechanical properties are associated first with rotational oscillations, over energy barriers, of short segments (of the order four methylene groups in length) of a chain (activation energy ~ 6 kcal/mole) and also with the γ-peak of the mechanical loss data. At temperatures exceeding the "glass transition temperature" the molecular movements are also described by neo-Brownian diffusional motions involving chain lengths of about 10 methylene groups (activation energy ~ 12 kcal/mole). These latter "neo-Brownian" motions are associated to some extent with the β-peak of the mechanical loss data and probably also involve some branch point motion. The majority of the motion occurs principally in the amorphous regions of the branched polyethylene until temperatures above 290°K are reached and the microstructure begins to change due to the "melting" of crystallites. The intensity ratio for the complex line shape exhibited by polyethylene at temperatures greater than 200°K are associated with the high-frequency rigidity of the sample. A.

539.2

406. NUCLEAR MAGNETIC RESONANCE STUDIES OF POLYETHYLENE.
R.C.Rempel, H.E.Weaver, R.H.Sands and R.L.Miller.
J. appl. Phys., Vol. 28, No. 10, 1082-9 (Oct., 1957).

Nuclear magnetic resonance (N.M.R.) studies of three polyethylenes were made over the temperature range −190°C to 120°C. Two components of the N.M.R. line were observed — a narrow one identified with the "amorphous" regions and a broad one identified with the "crystalline" regions. Differences between polyethylenes in the shape of the narrow component are observed and discussed. The variation of line width of the two components with temperature indicates two motional transitions occurring in the "amorphous" regions and one in the "crystalline" regions over the temperature range studied. Energies of activation inferred for one of the "amorphous" transitions agree well with those determined from melt viscosity studies implying a similarity of molecular processes controlling the two measurements and allowing an interpretation of the one observed by N.M.R. to be made. The N.M.R. data are used to interpret (in terms of molecular motions) the three dispersion regions observed by dynamic mechanical measurements, with the following results: in the vicinity of −100°C, the amorphous regions undergo a transition involving mainly the onset of rotation of linear segments of the polymer chains. Between −35°C and 0°C (depending on the sample), the motion of amorphous chain segments containing branch points leads to a transition. In the neighbourhood of 60-100°C (depending on the sample), there are the beginnings of observable motion of the chain segments within crystallites. Using a new method of decomposing the N.M.R. line into its two components (based on the experimental line shape at low temperatures), the relative intensities of the two components (hence, the relative amounts of fixed and moving nuclei) are determined. This ratio, previously held to be identical with the "percentage crystallinity", is shown to be inconsistent with this view and to support the molecular interpretation presented. A.

539.2

407. NUCLEAR MAGNETIC RELAXATION IN POLYTETRAFLUOROETHYLENE AND POLYETHYLENE.
C.W.Wilson,III and G.E.Pake.
J. chem. Phys., Vol. 27, No. 1, 115-22 (July, 1957).

Nuclear magnetic resonance studies of the linear chain polymer polytetrafluoroethylene (Teflon) indicate the coexistence of two phases, each characterized by its own pair of relaxation times T_1 and T_2. Decomposition of the complex resonance lines and complex saturation curves into normal curves permits determination of the fraction of nuclei in each phase. It is suggested that the phases are the crystalline and amorphous regions of these polymers, and some additional evidence to support this suggestion is presented. The phase thought to be crystalline shows a marked line-narrowing at the first-order thermodynamic-transition point near 293°K. The less complete data presented for polyethylene suggest the analogous presence of two phases, and the line-shape analysis yields reasonable values for the degree of crystallinity. A.

539.2

408. PROTON MAGNETIC RESONANCE STUDIES ON NATURAL RUBBER. II. LINE SHAPE AND T MEASUREMENTS.
H.S.Gutowsky, A.Saika, M.Takeda and D.E.Woessner.
J. chem. Phys., Vol. 27, No. 2, 534-42 (Aug., 1957).

For Pt I see Abstr. 3739 (1954). Proton magnetic resonance absorption measurements were made on samples of uncured Hevea, balata, and Coral rubber as well as on vulcanized samples with up to 9% combined sulphur. The motions of the chain segments were studied by observing line shapes and spin—lattice relaxation times at temperatures between −190 and 150°C. Several types of data show different molecular mobilities for vulcanized samples with a given combined sulphur but prepared by curing mixes with different fractions of raw sulphur for different times. Line-width studies of the uncured Hevea sample as a function of thermal history indicate that the molecular mobility decreases with increasing crystallinity. Chemical shifts were resolved in high resolution studies of solutions of uncured Hevea, balata, and Coral rubber. The T_1 measurements, including observations at 20 and 28 Mc/s on uncured Hevea and balata, exhibit systematic deviations from the B.P.P. theory. The significance of the deviations is discussed. A.

539.2

409. PARAMAGNETIC RESONANCE OF NICKEL FLUOSILICATE UNDER HIGH HYDROSTATIC PRESSURE.
W.M.Walsh, Jr and N.Bloembergen.
Phys. Rev., Vol. 107, No. 3, 904-5 (Aug. 1, 1957).

An apparatus allowing the study of electron spin resonance at high pressures is described, and results for $NiSiF_6.6H_2O$ up to 10 000 kg/cm² are reported. At 300°K the splitting, D, of the lowest level in the trigonal crystalline field varies linearly with pressure as $\partial D/\partial P = 0.834 \times 10^{-4}$ cm^{-1}/kg.cm^{-2}. D is found to be zero at 6200 kg. cm^{-2}. The g-value parallel to the trigonal axis is 2.34 at all pressures. A.B.Lidiard

539.2 : 539.374

PLASTIC DEFORMATION OF CRYSTALS. See Abstr. 424

539.21

410. BULK DENSITY OF SEPARATED LITHIUM ISOTOPES.
D.D.Snyder and D.J.Montgomery.
J. chem. Phys., Vol. 27, No. 5, 1033-4 (Nov., 1957).

The bulk density of extruded specimens of natural lithium and

of enriched isotopes (>90%) was measured by the flotation-equilibrium and by the hydrostatic-balance methods. Upon correction for the slight chemical and isotopic impurities and upon reduction to 20°C, the following results were obtained for the bulk density in g/cm^3 : Li^6, 0.460 ± 0.002; Li^7, 0.537 ± 0.003; lithium-natural, 0.531 ± 0.001. The crystal densities, calculated from the lattice constants determined by X-ray diffraction, are respectively 0.462, 0.539, 0.533, in each case about half a per cent higher than the bulk density. A.

539.21

411. RADIATION EFFECT OF POSITIVE ION BOMBARDMENT ON GLASS. R.L.Hines.
J. appl. Phys., Vol. 28, No. 5, 587-91 (May, 1957).

Bombardment of a silica-soda-lime glass (n_D = 1.5246) by more than 5 x 10^{16} A^+ ions/cm^2 with an energy of 33.5 keV reduces the reflection coefficient to 0.36 of its normal value for light of wavelength $\lambda = 0.6\ \mu$. The change in reflection coefficient is attributed to the formation of an altered glass layer. For a bombardment by 40 keV A^+ ions, the layer has a thickness of 0.095 μ and an effective refractive index of 1.343. The depth of the layer is determined by the ion energy and agrees approximately with the theoretical range of the incident ions. The refractive index of the altered layer is determined by the integrated flux of positive ions and the type of ion. The magnitude of the positive ion flux employed is shown to be orders of magnitude larger than the flux of primary "knocked-on" atoms produced by fast neutron bombardment in a reactor. A.

539.21

412. LOW-TEMPERATURE MEASUREMENTS OF THE YOUNG'S MODULUS AND INTERNAL FRICTION OF COPPER DURING IRRADIATION.
D.O.Thompson, T.H.Blewitt and D.K.Holmes.
J. appl. Phys., Vol. 28, No. 6, 742-3 (June, 1957).

Measurements on a copper single crystal were made during irradiation with a fast neutron flux of about 7 x 10^{11} neutrons/cm^2 sec in the O.R.N.L. graphite reactor at about 21°K. Graphs show the increase in resonant frequency of the crystal with bombardment time and the accompanying decrease in internal friction, and also the low temperature annealing effects. J.Adam

539.21

413. EXPANSIONS IN REACTOR IRRADIATED GERMANIUM AND SILICON. M.C.Wittels.
J. appl. Phys., Vol. 28, No. 8, 921 (Aug., 1957).

Unit cell size measurements made on single crystals irradiated with fast neutrons to a dose of about 4 x 10^{20} neutrons/cm^2 showed expansions of 0.055 ± 0.005% and 0.037 ± 0.005% for germanium irradiated at respectively 40°C and 140°C, and 0.017 ± 0.006% for silicon irradiated at 40°C. J.Adam

539.21 : 537.311.31

EFFECT OF CRYSTAL IMPERFECTIONS ON ELECTRICAL RESISTANCE OF METALS. See Abstr. 171

STRUCTURE OF SOLIDS

539.217

414. DIFFUSION OF CARBON ATOMS IN NATURAL GRAPHITE CRYSTALS. M.A.Kanter.
Phys. Rev., Vol. 107, No. 3, 655-63 (Aug. 1, 1957).

Diffusion in purified natural graphite crystals was studied by two techniques. Crystals with C^{14} atoms on the surface were prepared by heating at 1575°C for thirty minutes in a mixture of radioactive carbon monoxide and helium. These crystals were heated at diffusion temperatures in vacuo, and the C^{14} distribution within the crystals was determined by burning them slowly and measuring the radioactivity in the carbon dioxide produced. Diffusion measurements were carried out for times up to twenty-five hours in the temperature range 1995°-2195°C. The results indicated that simultaneous diffusion into single-crystal regions and into disordered regions occurred. Diffusion was also studied by measuring the rate at which C^{14} atoms were taken up by graphite crystals heated in radioactive carbon monoxide whose C^{14} concentration was maintained constant. Experiments were carried out for times up to eighty hours at temperatures in the range 1995°-2347°C. The results indicated that the greatest part of the flow of atoms into the crystals occurred by the process of volume diffusion at temperatures above 2150°C. The volume diffusion coefficient for graphite is $D = 40f^2 \exp[(-163\,000 \pm 12\,000)/RT]$, where f is a geometry factor used because of the irregular shape of the crystals and is estimated to be between 0.1 and 0.6. The volume diffusion coefficient reported appears to be that for the direction parallel to the layer planes. A.

539.219

415. RETROGRADE SOLUBILITY OF ALUMINUM IN SILICON. D.Navon and V.Chernyshov.
J. appl. Phys., Vol. 28, No. 7, 823-4 (July, 1957).

Experiments using temperature-gradient zone melting in the range 700°C to the m.p. of silicon showed a retrograde solubility of the aluminium. C.A.Hogarth

539.231 : 535.327.3

INHOMOGENEITIES IN TRANSPARENT PLASTIC SHEET. See Abstr. 105

539.234 : 537.311.31

416. A STUDY OF THE RESISTIVITY OF VERY THIN GOLD FILMS AS A FUNCTION OF THE THICKNESS, FOR VARIOUS FORMS OF SUBSTRATE. S.Minn and S.Offret.
J. Phys. Radium, Vol. 18, No. 5, 357-8 (May, 1957). In French.

Gold films evaporated on glass coated with bismuth oxide are more stable and of lower resistivity than those evaporated on uncoated glass. If the substrate is coated with magnesium fluoride the films show pronounced ageing effects and have still higher resistivity. Silver films give similar results, but for platinum none of these effects are observed. C.Hilsum

539.26

417. X-RAY STUDY OF ORDER IN THE ALLOY $CuAu_3$. B.W.Batterman.
J. appl. Phys., Vol. 28, No. 5, 556-61 (May, 1957).

Measurements of the integrated intensity of the superstructure reflections 100 and 110 from powders and a single crystal of $CuAu_3$ give a long-range order parameter S = 0.87 ± 0.04 for a temperature below T_C not well defined. At the composition $CuAu_3$, T_C = 199°C. With decreasing Au content, T_C increases. Compositions richer in Au than $CuAu_3$ could not be ordered. No annealing treatment was found which would sharpen the superstructure reflections. The breadths correspond to antiphase domains about 50 A in size. Measurements of the diffuse intensity from a single crystal of $CuAu_3$ quenched from 285°C, or held at temperatures of 250°C and 320°C, gave short-range order coefficients qualitatively similar to those for Cu_3Au. Compared with Cu_3Au, $CuAu_3$ shows a weaker first neighbour and a stronger second neighbour ordering. A.

539.27

418. CARBON-STABILIZED COLLODION SUBSTRATES FOR ELECTRON MICROSCOPY. W.C.T.Dowell.
J. appl. Phys. Vol. 28, No. 5, 634-5 (May, 1957).

A method for making a composite carbon—collodion substrate for use supporting electron microscope specimens is described. It is claimed that the new substrate has the advantages of the carbon films combined with the ease of mounting of collodion films. M.E.Haine

539.27

419. CONTAMINATION FROM COPPER SPECIMEN GRIDS DURING ELECTRON DIFFRACTION. J.J.Comer.
J. appl. Phys., Vol. 28, No. 7, 820 (July, 1957).

A new source of contamination is discovered from Cu specimen-grids during electron diffraction. This arises from Cu which is thought to have been evaporated from the surface of the specimen grids. J.Thewlis

ELASTICITY. STRENGTH. RHEOLOGY

539.31

420. ON THE ORIENTATION DEPENDENCE OF INTERNAL FRICTION. A.Granato and K.Lücke.
J. appl. Phys., Vol. 28, No. 5, 635 (May, 1957).

The decrements and modulus changes having their origins in dislocation motion are influenced by the orientation of the crystal and unless account is taken of this, a comparison of the measurements made in one frequency range with those in another may be seriously in error. The reasons are briefly explained and it is suggested that neglect of the orientation factor may account for the discrepancies that arise in attempts to measure the frequency dependence of the internal friction in the kilocycle range. A better procedure is to consider the ratio of the decrement to the modulus change as a function of frequency. H.J.H.Starks

539.32

421. INTERNAL FRICTION IN THE PRESENCE OF A STATIC STRESS. G.S.Baker.
J. appl. Phys., Vol. 28, No. 6, 734-7 (June, 1957).

The internal friction of pure lead, copper, and aluminium single crystals was measured as a function of an externally applied static biasing stress. The low strain amplitude damping of copper and lead was found to be essentially unaffected by the presence of the static stress. Aluminium differs from lead and copper in that at room temperature, damping is independent of amplitude at low strain amplitudes ($\epsilon < 10^{-6}$). The damping in aluminium becomes strain-amplitude dependent only at higher strain amplitudes. The presence of the static stress causes this amplitude dependence to shift to lower stress amplitudes by an amount comparable to the static stress applied. A.

539.32

422. ELASTIC CONSTANTS OF MAGNESIUM FROM 4.2°K TO 300°K. L.J.Slutsky and C.W.Garland.
Phys. Rev., Vol. 107, No. 4, 972-6 (Aug. 15, 1957).

The adiabatic elastic constants of magnesium single crystals were measured by an ultrasonic pulse technique. The values at 298°K are in good agreement with the recent values of Long and Smith. The values extrapolated to 0°K are $c_{11} = 0.635$, $c_{33} = 0.664$, $c_{44} = 0.1842$, $c_{12} = 0.259$, $c_{13} = 0.217$ in units of 10^{12} dynes/cm^2. A Debye characteristic temperature, θ, of 388 ± 3°K is calculated at 0°K by averaging the inverse cube of the longitudinal and transverse elastic-wave velocities over all directions of propagation. Atomic force constants for a central-force model with an electron gas term are also obtained. A.

539.37 : 536.48

423. LOW-TEMPERATURE DEFORMATION OF COPPER SINGLE CRYSTALS. T.H.Blewitt, R.R.Coltman and J.K.Redman.
J. appl. Phys., Vol. 28, No. 6, 651-60 (June, 1957).

Single crystals of copper were deformed at 4.2°K and 77.3°K. At 4.2°K, after a large strain produced by normal slip, jerky flow (discontinuous slip) occurs. From the study of reactor-irradiated crystals, it was deduced that a packet of 30 slip lines, each containing 10^4 dislocations, was released to form each jerk of the discontinuous flow. For samples of certain orientation the region of discontinuous flow was followed by a region of deformation twinning. The fact that deformation twinning was taking place was verified by X-ray methods. The twinning elements were determined to be the (111) plane and the [112] direction. At 77.3°K, discontinuous slip was not observed. In a limited range of orientations, twinning has been observed at 77.3°K. The effects of reactor irradiations on discontinuous slip and on twinning were also studied and it was determined that the occurrence of twinning was unaffected by the irradiations. A.

539.374 : 539.2

424. PLASTIC DEFORMATION OF CRYSTALS CAUSED BY ROTATION OF THE LATTICE WITHOUT FORMATION OF SLIP LINES. M.V.Klassen-Neklyudova and A.A.Urusovskaya.
Kristallografiya, Vol. 2, No. 1, 134-9 (1957). In Russian.

It is shown that kink bands in thallium halides (Abstr. 8274/1957) may be produced by rotation of the lattice without the accompaniment of linear slip. R.F.S.Hearmon

539.374

425. FOLDING INSTABILITY OF A LAYERED VISCOELASTIC MEDIUM UNDER COMPRESSION. M.A.Biot.
Proc. Roy. Soc. A, Vol. 242, 444-54 (Nov. 19, 1957).

A preliminary theory is established for the stability of a viscoelastic layer sandwiched in an infinitely extended medium of another viscoelastic material when a compressive force is acting in a direction parallel with the layer. The instability is manifested by a folding of the layer. It is shown that in general there exists a lower and a higher critical load between which folding occurs at a finite rate with a dominant wavelength. This is the wavelength whose amplitude increases at the fastest rate. Special cases are also discussed in more detail such as that of a purely viscous layer in a viscous fluid, an elastic layer in a viscous fluid, a viscous layer in an elastic medium, and of two Maxwell materials. Results indicate that the ratio of the relaxation times of the two materials is an important parameter. A.

539.42/.43

426. STRENGTH AND FATIGUE OF GLASS AT VERY LOW TEMPERATURES. R.H.Kropschot and R.P.Mikesell.
J. appl. Phys., Vol. 28, No. 5, 610-14 (May, 1957).

The strength and fatigue properties of borosilicate crown (BSC-2) optical glass were measured at various temperatures within the range 20°K to 296°K. Simple beam specimens with two-point loading were tested in both the abraded and unabraded condition. The breaking stress for a given condition increases with decreasing temperature. The fatigue decreases with decreasing temperature but still exists at 76°K. A.

539.42

427. TENSILE STRENGTH OF PLASTICS BELOW THE GLASS TEMPERATURE. F.Bueche.
J. appl. Phys., Vol. 28, No. 7, 784-7 (July, 1957).

The times taken for two plastics, polystyrene and polyethyl methacrylate, to break under various constant loads are reported for both the glassy and rubbery states. A theory is presented which describes the strength properties of plastics in the glassy state. The theory predicts that the logarithm of the time taken for the sample to break is proportional to the applied load. Such behaviour is actually found by experiment. The tensile data in the rubbery range are adequately represented by a theory previously developed for that region. A.

539.434 : 548

428. STEADY-STATE CREEP OF CRYSTALS. J.Weertman.
J. appl. Phys., Vol. 28, No. 10, 1185-9 (Oct., 1957).

An expression for the steady-state creep rate of crystals is derived for the case where dislocation climb is not rate controlling. Two rate-controlling processes are considered. In the first the dislocations are considered to move in a viscous manner, their velocity of motion being proportional to the force exerted on them. The second mechanism makes use of the Peierls stress. The Peierls stress mechanism can be used to explain the results of Gilman on creep by prismatic glide in high-purity zinc. At low stresses the analysis for both processes leads to a power law stress dependence for the creep rate. The value of the exponent of the stress is approximately equal to three. A.

539.62

429. MECHANISM OF WS_2 LUBRICATION IN VACUUM. V.R.Johnson, M.T.Lavik and G.W.Vaughn.
J. appl. Phys., Vol. 28, No. 7, 821 (July, 1957).

The lubrication mechanism of WS_2 is similar to that of MoS_2 (Abstr. 1696/1957). J.W.Menter

539.62 : 539.371

430. ELASTIC DEFORMATION AND THE LAWS OF FRICTION. J.F.Archard.
Proc. Roy. Soc. A, Vol. 243, 190-205 (Dec. 24, 1957).

This paper examines whether the hypothesis of elastic deformation of surface protuberances is consistent with Amontons's law, that the friction is proportional to the applied load. For a single elastic contact, the area of contact A is known to be proportional to the $\frac{2}{3}$ power of the load W. Since the frictional force is generally assumed to be proportional to A, it has been thought that in elastic deformation Amontons's law would not be obeyed. However, conforming surfaces usually touch at many points, and it is shown that in these circumstances A and W become nearly proportional. Experiments are described which show that the general law is that the friction is proportional to the true area of contact; whether or not Amontons's law is obeyed depends upon the surface topography. For highly elastic materials such as Perspex, Amontons's law is obeyed when the contact is made at many points, and other relations between A and W are observed when the contacts are few. Experiments with lubricated brass specimens show that the same conclusions apply to carefully prepared or well run-in metal surfaces running in conditions where the damage is small. A.

539.8 : 536.424

431. SOLID METHANE — CHANGES IN PHASE UNDER PRESSURE. R.Stevenson.
J. chem. Phys., Vol. 27, No. 3, 656-8 (Sept., 1957).

The solid phases of ordinary methane were studied under pressure at low temperatures by the volume discontinuity method. The phase diagram of the solid is presented. A new phase was observed, and the "missing" phase (by analogy to CD_4 and CD_3D) evidently appears only under pressure at liquid helium temperatures. Observations indicate another phase at high pressures in the low temperature region. Indications of correlations among the phase diagrams of CH_4, CH_3D and CD_4 are shown. A.

539.8 : 536.424

432. COMPRESSIONS AND SOLID PHASES OF CO_2, CS_2, COS, O_2, AND CO. R.Stevenson.
J. chem. Phys., Vol. 27, No. 3, 673-5 (Sept., 1957).

Compressions and phase diagrams for solid CO_2, CS_2, COS, O_2 and CO are presented for pressures up to 10 000 atm at low temperatures. A new modification of COS was observed under pressure. A.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.12

433. DEPENDENCE OF THE VELOCITY OF DETONATION OF NITROMETHANE ON ITS INITIAL TEMPERATURE. M.P.Murgai.
J. appl. Phys., Vol. 28, No. 6, 745 (June, 1957).

From the known change of the density of nitromethane with temperature the temperature coefficient of its detonation velocity is found to be −4.5 m/sec. deg C, fairly close to the value of −3.7 m/sec. deg C given by Campbell et al (Abstr. 9008/1956). R.C.Murray

541.123

434. APPLICATION OF NUCLEAR MAGNETIC RESONANCE TO THE STUDY OF ACID—BASE EQUILIBRIA.
E.Grunwald, A.Loewenstein, and S.Meiboom.
J. chem. Phys., Vol. 27, No. 3, 641-2 (Sept., 1957).

Acid—base equilibria in aqueous solutions of methylamine, dimethylamine, and trimethylamine were studied by nuclear magnetic resonance. It is shown that the chemical shift of the methyl protons is a linear function of the concentration ratio of acid to base plus acid. The N.M.R. spectrum of tetramethylammonium ion is also given. A.

541.124

435. SINGLE-PULSE SHOCK TUBE STUDIES OF THE KINETICS OF THE REACTION $N_2 + O_2 \rightleftarrows 2NO$ BETWEEN 2000-3000° K. H.S.Glick, J.J.Klein and W.Squire.
J. chem. Phys., Vol. 27, No. 4, 850-7 (Oct., 1957).

The single temperature pulse technique was used to study the kinetics of the formation of nitric oxide in the temperature range from 2000° to 3000° K. It was found that the kinetics of the reaction are consistent with the chain mechanism proposed by Zeldovich. The rate-determining step in the chain is $O + N_2 \rightarrow NO + N$, with $\Delta H_{2500^\circ} = 75.8$ kcal/mole. The activation energy for this step is found to be 74 ± 5 kcal/mole. The collision cross-section, as calculated from classical reaction rate theory, is 10^{-16} cm^2, which corresponds to a steric factor of about 0.05, assuming $\sigma_{N_2,O} = 5$ A. A.

541.124

436. ISOAFFINE REACTIONS. C.A.Hollingsworth and R.L.Potter.
J. chem. Phys., Vol. 27, No. 4, 896-8 (Oct., 1957).

Conditions for the possibility of isoaffine reactions are obtained in terms of the rank of a matrix involving the second-order derivatives of the thermodynamic potentials and in terms of the geometry of the Gibbs free energy surface. Conditions for isoaffine reactions in indifferent states are investigated, and it is shown that isoaffine paths exist for all reactions in the invariant and the monovariant systems at constant temperature and pressure. A.

541.128 : 548.74

437. COMBINED CATALYSTS AS REVEALED BY ELECTRON DIFFRACTION. S.Yamaguchi.
J. chem. Phys., Vol. 27, No. 5, 1114-15 (Nov., 1957).

Combined catalysts were studied by electron diffraction using alternate wavelengths. Three types of catalysts are distinguished from the results obtained. Either the substrate or the promotor predominates in the surface of the catalyst particle. There is another distribution of particles of solid phases in which neither phase envelops the other. A.

ELECTROCHEMISTRY

541.13 : 548

438. ELECTROCHEMISTRY OF METALLIC SINGLE CRYSTALS. I. EXCHANGE OVERVOLTAGES ON SILVER AND COPPER.
R.Piontelli, G.Poli and L.Paganini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1018-19 (April, 1957).

The anodic and cathodic behaviour of single-crystal surfaces before, during, and after the passage of rectangular current-pulses of duration up to 1 second was studied in various solutions. Differences in behaviour between the (100) and (111) lattice planes and between these and that of polycrystalline material were found, depending on the composition of the electrolyte and duration of the pulses. W.Good

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.14

439. PHOTOLYSIS OF WATER VAPOR.
M.C.Chen and H.A.Taylor.
J. chem. Phys., Vol. 27, No. 4, 857-63 (Oct., 1957).

The photolysis of water vapour was studied in a flow system at rates up to 5 mole. hr^{-1} and at temperatures up to 540° K under the influence of hydrogen discharge radiation around 1650 A. The products H_2, O_2 and H_2O_2 varied in amounts and proportions depending on the geometry of the system. Rapid removal of the products of photolysis from the reaction zone to a liquid N_2 trap favoured H_2O_2 production. Resultantly the quantum yield also varied with the geometry of the system, values from 0.03 to 0.3 were obtained. He as a diluent caused a decrease in H_2O_2 production. Added H_2 reduced H_2O_2 production tenfold, accounted for by its reaction with OH. A mechanism is discussed which is substantiated by a study of the dependence of the reaction rates on light intensity. A.

541.15

440. REDUCTION OF PLUTONYL SULPHATE BY γ-RAYS.
M.Pagès, C.Ferradini and M.Haissïnsky.
C.R. Acad. Sci. (Paris), Vol. 245, No. 14, 1128-9 (Sept. 30, 1957).
In French.

Aerated solutions of PuO_2^{2+} in sulphuric acid were irradiated with Co^{60} γ-rays under conditions such that 1 ml of solution absorbed 5×10^{18} eV/hr. The reduction proceeded linearly with absorbed energy to completion and stopped at Pu^{IV}, no Pu^{III} having been found. An "after effect" was observed with very dilute solutions. The G-value fell from 2.9 to 1 as the acidity was increased from 0.1 to 2N, at Pu^{VI} concentrations of 3×10^{-3} M. This variation is shown to be due to superposition of separate effects due to H^+-ions and to SO_4^{2-}-ions. C.B.Allsopp

DISPERSIONS. COLLOIDS. ADSORPTION

541.183

441. STATISTICAL MECHANICS OF FLEXIBLE HIGH POLYMERS AT SURFACES. H.L.Frisch and R.Simha.
J. chem. Phys. Vol. 27, No. 3, 702-6 (Sept., 1957).

The isotherm corresponding to monolayer adsorption and the equation of state of a monolayer at a liquid interface are derived. The number of segments per chain actually deposited is replaced by

an average value, which is proportional to $t^{1/2}$ (t total number of segments) and depends on chain flexibility. This introduces a considerable simplification. However, a previous overcounting of configurations on the surface is eliminated. This affects primarily the results at low surface coverage and leads to the anticipated limiting laws. The isotherms differ considerably, although not as much as for rigid macromolecules of equal chain length, from the Langmuir type. The change in surface tension in solution as a function of bulk concentration, molecular weight and solvent power is calculated. A.

CHEMICAL ANALYSIS

545.827

442. RADIOACTIVATION ANALYSIS — A BIBLIOGRAPHY.
D.Gibbons, B.A.Loveridge and R.J.Millett.
Atomic Energy Res. Establ. (Harwell) Rep. I/R2208, 37 pp. (1957).

This bibliography covers the literature which was available to the compilers up to the end of June 1957. 261 references are arranged alphabetically under authors. The subject index is in three parts: (1) reviews and general articles, (2) elements determined, (3) matrices. A.

545.827

443. ANALYSIS OF GASES AT VERY LOW PRESSURES BY USING THE OMEGATRON SPECTROMETER.
J.S.Wagener and P.T.Marth.
J. appl. Phys., Vol. 28, No. 9, 1027-30 (Sept., 1957).

A mass spectrometer of the omegatron type is described by which gases up to mass number 44 can be detected and analysed at pressures as low as 10^{-10} mm. Performance characteristics of this spectrometer are given together with a description of auxiliary vacuum equipment with which it was used for studies of high-vacuum phenomena. Results are given for analyses of: (1) The gas evolving from a number of materials used in high vacuum work; (2) the residual gas existing above getters of the flash type; and (3) the residual gas in television picture tubes. The gases found in the residual gas mainly are argon, methane, and water vapour. A.

CRYSTALLOGRAPHY

548.1

444. EXTENSIONS OF SPACE-GROUP THEORY. A.L.Mackay.
Acta cryst., Vol. 10, Pt 9, 543-8 (Sept., 1957).

Recent papers re-examining the effect of including an operation of antisymmetry among the permitted elements of symmetry and making further generalizations of the space groups are reviewed. Suggestions are made, and developed for the two-dimensional case, for further elaboration arising from the superposition of symmetrical and antisymmetrical groups. The description of the physical properties of crystals is a possible field of applicability. A.

548.1

445. SYMMETRY AND DIFFERENT KINDS OF ANTISYMMETRY OF FINITE FIGURES. A.M.Zamorzaev and E.I.Sokolov.
Kristallografiya, Vol. 2, No. 1, 9-14 (1957). In Russian.

It is found that Shubnikov's conception of antisymmetry (see the preceding abstract) can be generalized by attributing two signs to each point of the figure. Different kinds of antisymmetry result, depending on whether the first, the second or both signs change under the antisymmetry operation. R.F.S.Hearmon

548.1

446. SHUBNIKOV GROUPS.
N.V.Belov, N.N.Neronova and T.S.Smirnova.
Kristallografiya, Vol. 2, No. 3, 315-25 (1957). In Russian.

When the operation of antisymmetry (see the preceding two abstracts) is taken into account, the number of translational lattices, including the normal 14 Bravais lattices, amounts to 36. There are 1651 space groups based on these lattices. Diagrams are given of the lattices, and a complete tabulation, in international notation, is made of all the space groups. R.F.S.Hearmon

548.52

447. STATISTICAL THEORY OF CRYSTALLIZATION.
É.A.Arinshteĭn.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 6, 1189-91 (1957). In Russian.

Using the previously developed method (Abstr. 5718/1957), the author develops expressions for a more general case of multicomponent systems with short-range forces; a concrete case of a crystal of the β-brass type is considered in detail, and conditions are found at which continuous crystallization is possible.

F.Lachman

548.57

448. GROWTH OF TELLURIUM SINGLE CRYSTALS BY THE CZOCHRALSKI METHOD. T.J.Davies.
J. appl. Phys., Vol. 28, No. 10, 1217-18 (Oct., 1957).

Single crystals of Te (7.5 cm long, 1.5 cm dia.) were grown from seeds by the vertical pulling method. The Te charge was contained in a quartz-lined graphite crucible heated by induction in a H_2 atmosphere. The pulling rate was between 2 and 5 cm/hour with 16 r.p.m. crucible rotation, the temperature was controlled to ±0.15 deg. C. J.Franks

548.574

449. SPIRAL ETCH PITS IN SILICON.
T.L.Johnston, C.H.Li and C.I.Knudson.
J. appl. Phys., Vol. 28, No. 6, 746 (June, 1957).

Two types of etch pits were developed on (111) and (110) surfaces of n-type Si, large pits were associated with edge dislocations, and small pits containing spiral terraces with screw dislocations.

J.Franks

548.574

450. ETCHING OF SINGLE CRYSTAL GERMANIUM SPHERES.
R.C.Ellis, Jr.
J. appl. Phys., Vol. 28, No. 9, 1068 (Sept., 1957).

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS.
See also under "Structure of solids". Decimal classification 539.26/.27

548.734 : 518.5

451. THE USE OF A HIGH-SPEED DIGITAL COMPUTER FOR THE DIRECT DETERMINATION OF CRYSTAL STRUCTURES. II.
W.Cochran and A.S.Douglas.
Proc. Roy. Soc. A, Vol. 243, 281-8 (Dec. 24, 1957).

For Pt I see Abstr. 3281 (1955). This paper discusses some possible procedures for crystal structure determination using the χ criterion developed in the preceding paper of the series. In that paper it was shown that, under favourable circumstances, the signs of the largest terms in the Fourier series representation of ρ, the electron density in the unit cell, can be determined directly. The magnitudes of these terms can be found by experiment. In less favourable cases the correct set of signs, to a high degree of probability, lies among several hundred possible sets which can be determined by the processes described. A new criterion is proposed for selection of a lesser number, say a dozen, "most probable" sets of signs. These latter sets can be tested by inspection of the corresponding contour maps of ρ. The new criterion has been successfully used in determining the unknown structure of nitroguanidine. Techniques for the selection of most probable sets and also for evaluation of ρ at suitable points in space using an electronic computer, the EDSAC, are described. A.

548.735

452. PRECISION DETERMINATION OF LATTICE CONSTANTS. III-V. H.Weyerer.
Z. angew. Phys., Vol. 8, No. 11, 553-9 (Nov., 1956). In German.

For previous part, see Abstr. 7843 (1956). Pt III deals with the back-reflection method with flat-film recording; Pt IV with the back-reflection method with flat specimen and cylindrical film; and Pt V

with the comparison of a number of measurements on gold. The mean value finally obtained for the lattice constant of gold at 25°C is 4.070 106 ± 0.000 008 kX (not corrected for refraction).
A.R.Stokes

548.736.1

453. LATTICE CONSTANTS OF SEPARATED LITHIUM ISOTOPES. E.J.Covington and D.J.Montgomery.
J. chem. Phys., Vol. 27, No. 5, 1030-2 (Nov., 1957).

The lattice constant for highly enriched (> 99%) samples of Li^6 and Li^7 metal was determined at 20°C by X-ray diffraction methods. The constant for Li^6 was found to be fractionally larger than that for Li^7 by about 4×10^{-4}. These results are not inconsistent with a rough theoretical estimate for the fractional difference of 3×10^{-4} It is likely that the constant for Li^7 does not differ from that for natural lithium by more than 1×10^{-4}. The fact that the lighter isotope has the larger lattice constant constitutes experimental evidence for the reality of zero-point energy. A.

548.736.4 : 538.22

STRUCTURE OF Li_2NiF_4. See Abstr. 228

548.737

454. CRYSTAL-STRUCTURAL RELATIONS BETWEEN DIPHENYL AND A SERIES OF NEW DERIVATIVES OF IT. M.Fenoglio.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 765-72 (April, 1957). In Italian.

Lattice parameters, space-groups and optical constants are given for the di- and tri-methyl-nitro and the di- and tri-methyl-chloro derivatives of diphenyl. The orientations of the molecules are indicated by the optical constants. A.R.Stokes

548.74

455. THE STRUCTURE OF PbTe EVAPORATED LAYERS. L.Reimer.
Naturwissenschaften, Vol. 44, No. 15, 416-17 (1957). In German.

Evidence is obtained from electron diffraction on the texture of PbTe layers deposited on Formvar and on a NaCl crystal.
A.R.Stokes

548.74 : 539.234

456. ON THE STRUCTURE OF THIN SHEETS OF ALKALI HALIDES EVAPORATED ON SINGLE CRYSTAL SUBSTRATES. II. H.Lüdemann.
Z. Naturforsch., Vol. 11a, No. 11, 935-42 (Nov., 1956). In German.

For Pt I, see Abstr. 7045 (1954). A detailed study, by electron diffraction, of the orientations of the deposited layers, in which three different stages are recognized and described. The alkali halides are laid down, in a high vacuum, on single crystals of other alkali halides. J.Thewlis

548.74

457. ELECTRON DIFFRACTION PHOTOGRAPHS OF NEW TYPES OF Zn–Bi ALLOYS. H.Bülow.
Z. Phys., Vol. 148, No. 3, 321-32 (1957). In German.

Thin sheets of Zn–Bi alloys of various compositions were obtained by evaporation at 4.2°K and the relationship between resistance and crystal structure examined. The relationship in the range 0-50 atomic % Bi was different from that in the range 50-100 atomic % Bi. Each alteration of resistance was accompanied by corresponding changes in the electron diffraction photographs and an explanation is given in terms of the recrystallization processes involved.
J.Thewlis

548.74 : 541.128

COMBINED CATALYSTS AS REVEALED BY ELECTRON DIFFRACTION. See Abstr. 437

GEOPHYSICS

ATMOSPHERE. METEOROLOGY

551.510.535 : 621.396.812

458. IONOSPHERIC TURBULENCE AND THE PROPAGATION OF ELECTROMAGNETIC WAVES. T.Kahan.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1352-84 (1956). In French.

Following a detailed discussion of the general phenomenon of turbulence, its application to ionospheric propagation is treated mathematically. This turbulence is assumed to give rise to fluctuations of the dielectric constant which cause temporal and spatial changes of all the ionospheric characteristics. It is believed that these account for the radio propagation on frequencies of the order of 50 Mc/s to distances of 1000-2000 km which are observed when all normal forms of ionospheric transmission are absent. The energy is considered to arise from solar radiation and from the impact of meteors in region E. G.M.Brown

551.510.535

459. SOME PROPERTIES OF THE METEORIC E-LAYER USED IN RADIO WAVE PROPAGATION. R.Naismith.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1413-21 (1956).

Evidence from vertical and oblique radio soundings is given for the existence of a so-called "meteoric E layer" situated in the E-region, and produced by the ionization accompanying the impact of sporadic meteors at this level. This layer constitutes a part, but not the whole, of the sporadic-E ionization. G.M.Brown

551.576

460. RECENT DEVELOPMENTS IN CLOUD PHYSICS. B.J.Mason.
Nature (London), Vol. 180, 573-4 (Sept. 21, 1957).

Report of a meeting of the Royal Meteorological Society held at Glasgow on 3-5th July 1957. This session had three papers, one on the growth of ice crystals by B.J.Mason, one on condensation nuclei by R.J.Murgatroyd and a third by T.W.Wormell describing electrification processes associated with precipitation near the ground.
J.M.Hough

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.594.13 : 621.317.73

461. METHODS USED IN MEASUREMENT OF THE ELECTRICAL CONDUCTIVITY OF AIR.
G.Vasiliu, N.Calinicenco and V.Mateiciuc.
Bul. Inst. Politeh. Iaşi, Vol. 2(VI), No. 1-2, 67-80. In Rumanian.

The importance of such measurements in the study of meteorology, geological strata, radioactive deposits and problems of electrical power transmission is indicated. The theory and function of a cylindrical ionization chamber with controlled air-flow is described, for the following cases of air speed through the chamber: zero, increasing to a fixed value U_0 at which all ions are still being captured; in excess of U_0 and with fixed potential applied across the chamber; and lastly, constant speed and variable potential. Experimental results show the best working regions for studying conductivity or ion density. A measuring apparatus is described working on the principle of charge compensation in conjunction with a null-reading meter: this method is suitable for high precision and remarkably rapid measurements in the field. A series of experimental results obtained both with a Gerdien aspirator and the compensated null-reading apparatus are given. A.Reiss

551.594.2 : 621.316.98

462. THE ELECTRIFICATION OF PRECIPITATION AND THUNDERSTORMS. R.Gunn.
Proc. Inst. Radio Engrs, Vol. 45, No. 10, 1331-58 (Oct., 1957).

This is a review paper. The fundamental physical processes responsible for the observed electrification of ordinary precipitating clouds, as well as thunderstorms, is considered in quantitative terms and new facts are emphasized. Cosmic rays and radioactivity, sometimes supplemented by corona and photoionization, produce ion pairs in the atmosphere. These ions are transferred to cloud droplets or ice crystals by diffusion or by electric fields and thereby establish a droplet charge distribution. This distribution is profoundly influenced by the observed differences between the positive

and negative light ion conductivities in the atmosphere. Electrification by induction frequently supplements these processes. Rain formed by the association of these cloud elements may be highly electrified and a mixture of positive and negative drops is usually produced. Experimentally well-established processes are considered that can selectively charge such rain or selectively discharge it. It is shown that either process can establish a free space distribution that is transferred toward the ground by gravity, and may be large enough to develop electric fields exceeding the dielectric strength of air. Lightning then intervenes. The conditions necessary to establish gross free charge distributions by regeneration are specified and shown to be met under frequently occurring meteorological situations. Many of the observed characteristics of thunderstorms are traceable to the nonuniform semiconducting nature of the lower atmosphere and its nonohmic behaviour. A.

551.594.5

463. PHOTOMETRIC OBSERVATIONS OF RAYED AND PULSATING AURORAE. A.Omholt.
Astrophys. J., Vol. 126, No. 2, 461-3 (Sept., 1957).

Using narrow-band (40A wide) interference filters to isolate the auroral radiations at 3914, 4709 A (N_2^+), 4861 A (Hβ), and 5577 A (O I) from a circular area of sky of only 0.5 sq. degree, the intensity ratios, I(4861/4709) and I(5577/3914) were measured photoelectrically. The results indicate that when pulsating rays occur more than one-half the total radiation can originate from a quasi-steady, structureless background. Both intensity, and behaviour of the auroral H lines appear to vary with latitude, in a way that suggests that protons are not the sole source of excitation even when the H lines are intense. Other types of fast particles, possibly electrons, are more important as exciters, except for low-latitude aurorae. D.R.Barber

551.594.6

464. DIURNAL VARIATION IN THE OCCURRENCE OF "DAWN CHORUS". J.H.Pope.
Nature (London), Vol. 180, 433 (Aug. 31, 1957).

Observations of "dawn chorus" were made between January 1 and July 2, 1956, at College, Alaska, with equipment sensitive to frequencies from 1 to 10 kc/s. The phenomenon was present in 224 of the 2784 one-minute hourly observing periods. A histogram of the records for each hour of the day shows that the time of maximum occurrence of "dawn chorus" is 1400 hr local time. Observations at other stations in New Zealand, the United States and England are quoted showing that the local times of the daily maximum in the occurrence of the effect range from 0200 at Wellington, New Zealand, geomagnetic latitude 45° S, to 1400 at Alaska, geomagnetic latitude 65° N, a graph indicating an approximately linear relation between local time of daily maximum and geomagnetic latitude. Since the daily maximum does not, in general, occur at dawn, it is suggested that the phenomenon be referred to simply as "chorus". A.Wilkinson

551.594.6

465. THE "DAWN CHORUS" IN RADIO OBSERVATIONS. G.A.Isted and G.Millington.
Nature (London), Vol. 180, 716 (Oct. 5, 1957).

The term "dawn chorus" was adopted by the late K.W.Tremellen on account of the similarity in sound of this "whistler" phenomenon to the dawn chorus of the birds; he was well aware that the phenomenon was not confined to the dawn. Pope's suggestion (see the preceding abstract) that it should be called simply "chorus" obscures the origin and purpose of the term and it is suggested that "dawn chorus" should be retained, with a reference, if necessary, to its true significance in relation to the characteristic sound of the phenomenon. A.Wilkinson

BIOLOGY

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

612.783

466. ON THE AIR RESISTANCE AND THE BERNOULLI EFFECT OF THE HUMAN LARYNX.
J.van den Berg, J.T.Zantema and P.Doornenbal, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 626-31 (May, 1957).

A model of the larynx was constructed, and measurements of air resistance for this model were made. The d.c. resistance R was measured for diameter d of the glottis from 0.1 to 3.2 mm, for subglottic pressures P_s up to 64 cm water and/or volume velocities v up to 2 litre/sec. To a good approximation, the resistance was equal to the sum of a frictional term, proportional to d^{-3}, and a turbulence term, proportional to vd^{-2}. The frictional term dominates at small diameters and/or small volume velocities, with v proportional to $P_s d^3$ and the differential resistance $R_d = R$. The turbulence term dominates at large diameters and/or large volume velocities, with v proportional to $P_s^{1/2} d$ and $R_d = 2R$. Over the major region the pressure at the outlet of the glottis was about $-\frac{1}{2}P_B$, where P_B is the kinetic pressure in the glottis, and the pressure over the entry of the glottis was about $1.37P_B$. The applicability and the implications of the results to various problems of normal voice production are discussed. A.

612.84

467. MOVING VISUAL IMAGES PRODUCED BY REGULAR STATIONARY PATTERNS. D.M.MacKay.
Nature (London), Vol. 180, 849-50 (Oct. 26, 1957).

Experiments are described in which stationary patterns produce after-images in apparent motion. The site of the phenomenon is discussed tentatively. R.A.Weale

612.843.721

468. CONVERGENCE FUNCTION IN BINOCULAR VISUAL SPACE. I. A NOTE ON THEORY. T.Shipley.
J. Opt. Soc. Amer., Vol. 47, No. 9, 795-803 (Sept., 1957).

A review and elucidation of the theory of the convergence function is presented. In this connection, certain phenomenal aspects of binocular visual experience are noted; it is felt that any general theory must take cognizance of them. In particular, the Luneburg theory of the alley experiments is discussed in some detail, and an attempt is made to highlight the underlying and possibly equivocal assumptions. In emphasizing the distinction between pure mathematical postulates and pure phenomenal experience, it is hoped both to clarify those points at which arbitrary decisions may legitimately enter into the theory (e.g., the normalization), and to set the stage for deliberate experimentation. A.

612.843.721

469. CONVERGENCE FUNCTION IN BINOCULAR VISUAL SPACE. II. EXPERIMENTAL REPORT. T.Shipley.
J. Opt. Soc. Amer., Vol. 47, No. 9, 804-21 (Sept., 1957).

Experimental evidence, concerning the functional relationship between distance perception and convergence, was gathered from several regions of binocular visual space, namely: within, above, and below the eye-level plane; and is discussed in terms of an intrinsic geometry of binocular visual space. Using the Hillebrand alley experiment as a base, and assuming Luneburg's choice of geodesics, it is possible to fit both classical and current data with a variety of functions. Within the limits imposed by confined laboratory conditions, any of these functions would permit qualitative predictions. Quantitative predictions necessitate further empirical evidence on distance perception for small angles of convergence, i.e., for very distant objects. A review of all the available data leads one to question Luneburg's choice of the geodesic for the parallel alleys. The suggestion is made to refer the definition of the geodesic to the far point, rather than to the visual axis passing through the two eyes. Among other things, this could have the effect, ceteris paribus, of changing the curvature of visual space from negative to positive — given the aggregate results of the alley experiments as they now stand. Thus, the specification of the parallel alley geodesic must take precedence over the determination of the sign of K. In fact, until the implications of this suggestion are more fully understood, and tested, one cannot determine the sign of the curvature from the alley experiments. A.

612.858.751

470. MECHANISM OF BINAURAL FUSION IN THE HEARING OF SPEECH. B.McA.Sayers and E.C.Cherry.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 973-87 (Sept., 1957).

The mechanism of binaural fusion is discussed as a form of

statistical operation based upon the brain's execution of running cross-correlation of the two ear signals. The technique of measurement of the degree of binaural fusion, outlined in an earlier paper, is extensively applied to sine waves, to chords of sine waves, to intoned vowels and to running speech; such technique results in curves which assess a listener's judgments as to whether a source of sound lies in the right or left hemisphere of subjective space. An extended theory is also developed explaining these judgment curves in detail. Finally, a discussion is made of the importance of having an understanding of the mechanism of binaural fusion, in any consideration of binaural directivity sense and speech discrimination sense (the "cocktail party problem"). A.

614.898 : 533.51

471. X-RAY RADIATION HAZARD USING VACUUM DEPOSITION PLANT. L.Holland.
Nature (London), Vol. 180, 89 (July 13, 1957).

Refers to previous work (Abstr. 9159/1956), where X-ray radiation hazard was observed with a special type of sputtering plant operated at 8-10 kV. Describes briefly tests made with a normal vacuum deposition plant. No X-ray hazard was observed even with operating voltages up to 20 kV. J.M.Zarzycki

TECHNIQUE. MATERIALS

669

472. ON THE CRUCIBLE PROBLEM DURING EXTENSIVE HEATING OF GERMANIUM. W.Bösenberg.
Z. angew. Phys., Vol. 8, No. 11, 551-2 (Nov., 1956). In German.

Intrinsic crystals were heated for 100 to 200 hours at 900°C in clean sealed quartz ampoules with and without clean graphite crucibles. Impurities taken up were frozen in through quick cooling. From the results of four experimental arrangements the author concludes that clean graphite introduces no detectable impurities but these may diffuse in through hot quartz walls. D.Haneman

669 : 534.321.9

VIBRATION TREATMENT OF METALS. See Abstr. 97

669.3

473. THE WORLD'S COPPER RESOURCES. H.J.Miller.
Proc. Instn Elect. Engrs, Paper 2455U, publ. Dec., 1957 (Vol. 104A, 522-3).

PHOTOGRAPHY

771.531

474. ON THE EFFECT OF GRANULARITY ON DYNAMIC RANGE AND INFORMATION CONTENT OF PHOTOGRAPHIC RECORDINGS. L.Levi.
J. Opt. Soc. Amer., Vol. 48, No. 1, 9-12 (Jan., 1958).

The presence of graininess in a photographic emulsion provides a threshold below which a signal will not be detectable. Graininess thus acts as a limiting factor on dynamic range. Granularity data of photographic emulsions are used to determine the minimum usable spot size when the dynamic range or the number of discernible grey steps of the recording is specified, or the resulting dynamic range, if the resolution element size is specified. A brief analysis is made of the information content as affected by the element size, i.e., scanning spot size. A.

771.535 : 778.34

475. ON A QUANTITATIVE EXAMINATION OF THE PROCESS OF FORMATION OF THE LATENT PHOTOGRAPHIC IMAGE BY IONIZING PARTICLES. A.L.Kartuzhanskiĭ.
Dokl. Akad. Nauk. SSSR, Vol. 114, No. 6, 1199-202 (1957). In Russian.

A method of analysis of emulsion characteristics is developed which allows the determination of such quantities as the number of conduction electrons liberated in each emulsion crystal, the loss of conduction electrons, and the minimum path length of an ionized particle through a crystal necessary to form a subsequent development centre. Examples of the method are described. W.O.Lock

778.33 : 616.073.75

476. THE INFLUENCE OF EDGE SHARPNESS AND CONTRAST ON THE PERCEPTIBILITY OF DETAIL IN PHOTOGRAPHY, WITH ESPECIAL REFERENCE TO DIAGNOSTIC RADIOLOGY.
R.Röhler.
Z. angew. Phys., Vol. 8, No. 12, 577-80 (Dec., 1956). In German.

A formula is evolved for the dependence of perceptible detail on film surface area and on contrast, perceptible detail being expressed by the probability with which differences in blackening can be associated with true detail as distinct from statistical variations. Contrast and unsharpness as factors affecting perceptibility of detail are separated quantitatively. The statistical variations in film blackening are shown by experiment to fall within a normal distribution. D.V.Mabbs

778.37 : 621.385.832

477. AN IMAGE-CONVERTER TUBE FOR HIGH-SPEED PHOTOGRAPHIC SHUTTER SERVICE.
R.G.Stoudenheimer and J.C.Moor.
R.C.A. Rev., Vol. 18, No. 3, 322-31 (Sept., 1957).

A developmental tube having electrostatic focus, a shutter grid, and electrostatic deflection is described. This tube is intended for multiple-frame photography of high-speed events as short as ten millimicroseconds. Operating characteristics of the tube are described, with emphasis on the low gating-power and deflection-power requirements. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published with the Index to this volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

J. Madras Univ. B.	Journal of Madras University (Section B). The University Buildings, Madras 5, India.

NEW JOURNALS

New Zealand J. Sci.	New Zealand Journal of Science. Department of Scientific and Industrial Research, Box 8018, Wellington, New Zealand. Replaces (with the New Zealand Journal of Agricultural Research and the New Zealand Journal of Geology and Geophysics) the New Zealand Journal of Science and Technology.
Trans Engng Inst. Canada	Transactions of the Engineering Institute of Canada. 2050 Mansfield Street, Montreal 2. No. 1 dated September, 1957.

NOTES

Bull. Acad. Polon. Sci., Cl. III	Bulletin de l'Académie Polonaise des Sciences, Cl. III. From the beginning of 1958 this journal will appear in two series, Series A: Mathematics, Physics, Astronomy and Series B: Chemistry, Geology, Geography.
Proc. Phys. Soc.	Proceedings of the Physical Society. From January 1958 the Proceedings will be published in one issue each month, instead of in two Sections, as hitherto.

NOTE ON THE ARRANGEMENT OF ABSTRACTS.

With the commencement of Volume 61 (1958), some alterations have been made in the order of the "chapters" in which the abstracts are grouped, and some new ones have been introduced, which can be identified by inspection of the list inside the front cover. These are in accordance with recently authorized alterations in the Universal Decimal Classification, which is undergoing an extensive programme of revision to bring it more into line with the present state of physical knowledge. The subdivision of the new sections is still under discussion, and no authorized schemes have yet been published.

ERRATA

July (1957) p. 605 column 2 : the abstract numbered "6494" should be "6594".
Abstr. 873 (1957) line 3 : for "A.R.B. Skertchley" read "A.R.B. Skertchly".
Abstr. 4227 (1957) line 3 : for "C.F.Alfrey" read "G.F.Alfrey".
Abstr. 5420 (1957) line 2 : for "I.Friedman" read "L.Friedman".
Abstr. 5718 (1957) line 2 : for "É.A.Arnshteĭn" read "É.A.Arinshteĭn".
Abstr. 5975 (1957) line 2 : for "L.A.Korostileva" read "L.A.Korostyleva".
Abstr. 5977 (1957) line 2 : for "M.H.Oganov, A.R.Striganov and Y.P.Sobolev" read "M.N.Oganov, A.R.Striganov and Yu.P.Sobolev".
Abstr. 6495 (1957) line 6 : for "y-background" read "γ-background".
Abstr. 6666 (1957) line 12: for "HN_3*" read "NH_3*".
line 13: the equation should read "$NH_2 + H \rightarrow NH_3$*".
Abstr. 6797 (1957) line 3 : for "C.von Békésy" read "G.von Békésy"
Abstr. 8165 (1957) line 4 : for "NEUTRAL" read "NEUTRON".
Abstr. 8443 (1957) line 2 : for "B.N.Grechushnikov" read "B.I.Grechushinikov".

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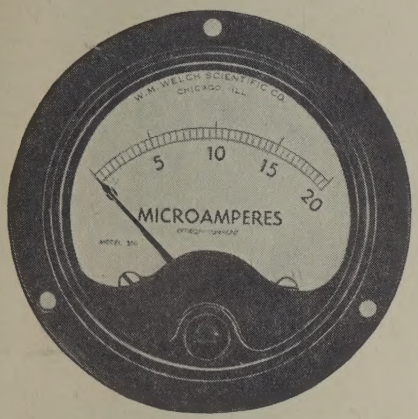

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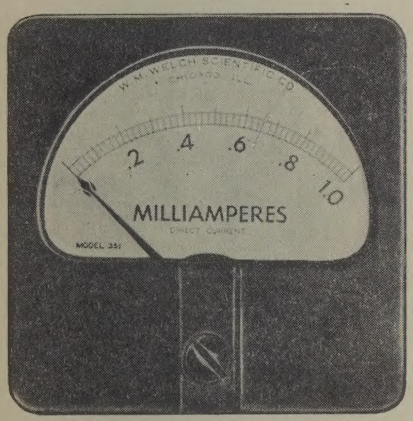

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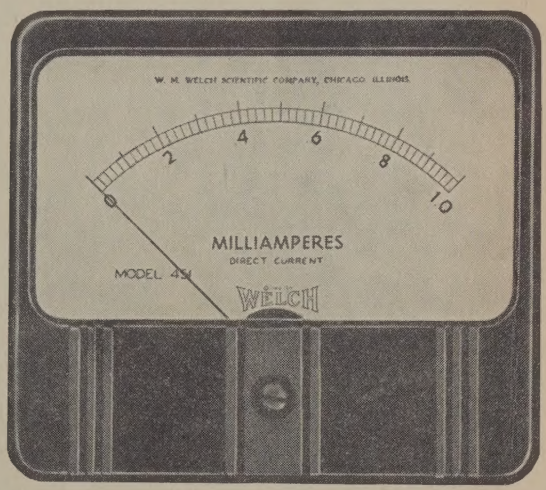

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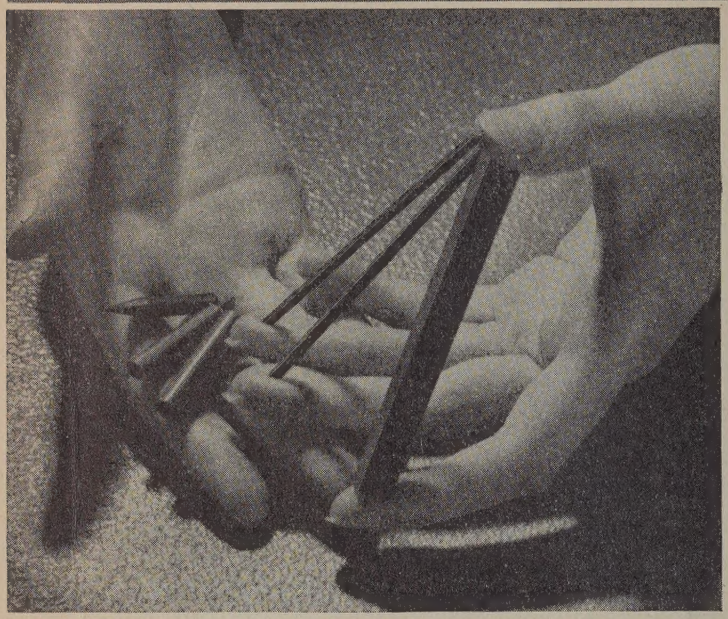

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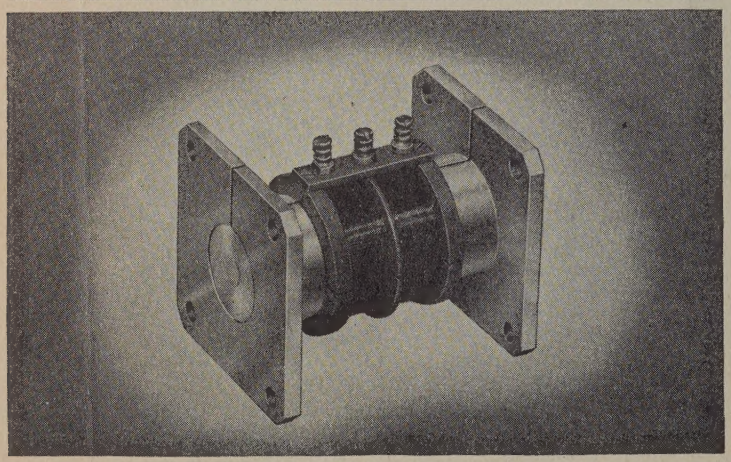

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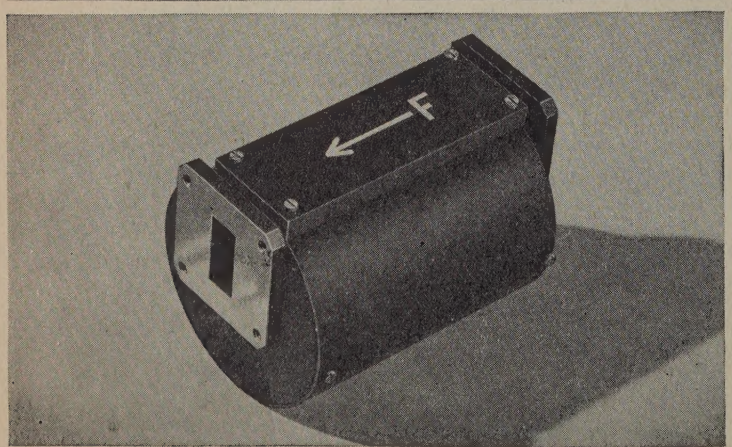

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